POWER

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Happy New Year

THE earth has made another lap in its ceaseless course about the sun and we begin to count the lengthening days and prepare for the annual miracle of spring.

The Twentieth Century is more than a quarter gone. When we entered it twenty-six years ago, we looked back curiously if not contemptuously upon the practices, customs and conditions of the first quarter of the Nineteenth Century.

What will our descendants who date their letters 2000-odd think of what we are doing now?

Will man have got over being man's worst enemy and spending a large part of his time and money and energy in devising schemes for attacking or repelling the attacks of other men?

At this point in the last century the first American railroad was yet to be built, the telegraph had not been invented, people depended upon candles for light and open fireplaces for heat. The man who seriously predicted the wonders that electricity has wrought, who talked of hundred-story buildings, steam-driven units up toward 300,000 horsepower, of streets congested by power-driven vehicles, of movies, radio, speech and perhaps vision at a distance without material connection would have been shunned of his fellows as a lunatic.

What is mankind going to accomplish in the next three-quarters of the century? What progress will be made in applying the results of all this research and discovery and invention and development to the realization of that universal well-being toward which the race has been struggling since man began to think and aspire?

Shall we soon begin to take account of this prodigious physical and material development and to evaluate and perhaps to concern ourselves with its effect upon the mental and ethical and spiritual advancement of the people?

May the year to come bring to you all a full measure of prosperity, success and happiness.

A Review of the Year's

Progress in the Power Field

SHOWS all power output and capacity records to have been broken. Interconnection of power systems increasing rapidly and water-power developments making good progress. Rate of 12,600 B.t.u. per kw.-hr. maintained in steam plant for full month. Higher pressures in ascendancy, with promise of higher temperatures soon. Rapid progress in water-cooled surface and air preheaters. Unit mills popular in powdered-coal plants. Modern stoker plants are equaling powdered-coal records. Steam turbines have grown to enormous proportions. Activity in new and improved industrial power plants where co-ordination of power, process and heating is reflected in marked economies.

IN THE power-plant field manufacturers of equipment and supplies generally agree that 1926 was a good year. Profits were normal and competition no more difficult to meet than in years past. With the many new developments that have not settled definitely into standardized practice, conditions have been more complicated, but it has been this very search for higher economies in all types of plants that in part at least, has created the volume needed for profitable business. Moreover, prospects appear good for the coming year.

During the year all power output and capacity records were broken. This in itself is an indication of prosperous times, as the power consumption of the country is now accepted as an excellent barometer of business conditions.

According to government figures the total productive capacity of the United States had reached on Sept. 1, fifty million horsepower, giving a prime mechanical force of 425 hp. for each 1,000 of population, or nearly one-half horsepower for each inhabitant. On the same basis the prime-mover capacity in 1900 was 168, ten years later it had reached 275, in 1920 the figure was 379 and in the succeeding six years the increment was 46, giving the foregoing total of 425. In other words, primary power from utility and industrial plants increased from 12,788,000 hp. in 1900 to 50,000,000 hp. in September of 1926.

Interchange of Power

Results of this growth are evident in stations of great size. Plants up to one million kilowatts capacity are in the making. In all parts of the country utility consolidations are developing into state-wide systems and these systems are being interconnected into a vast network covering an entire section of the country. For example, the final gap in a giant electric system connecting Chicago to Pittsburgh by a 130,000- and 66,000-volt continuous tower line has been completed. The power is supplied and carried by various companies, and through their network of transmission systems the energy is distributed into nine different states.

On Nov. 19 electric power communication was established between Chicago and Boston by relaying from one station to another. This was done merely for demonstration purposes, but shows to what extent interconnection has taken place.

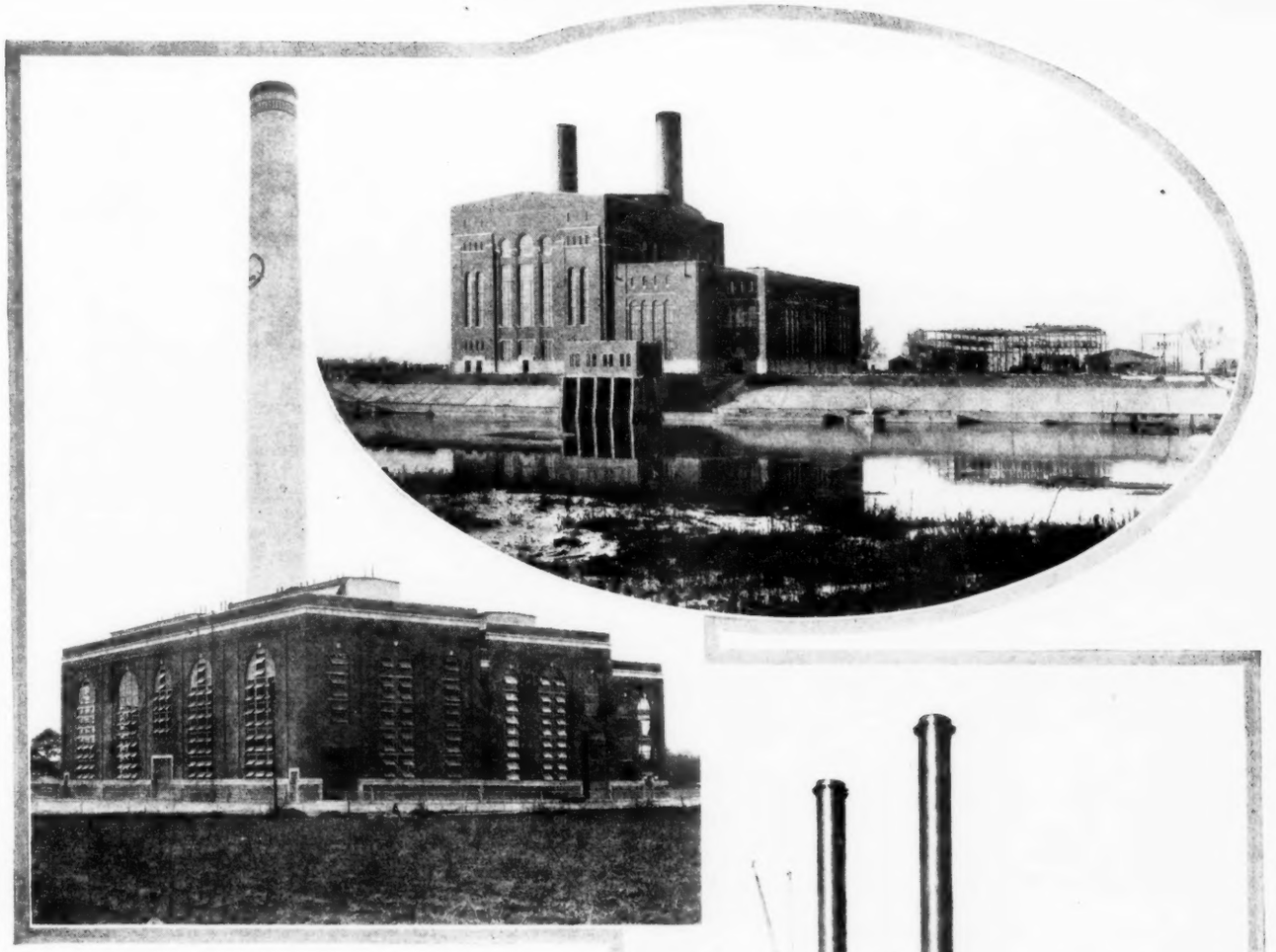
There is no denying that interchange of power between utilities is well established and has resulted in promoting continuity of service, reduction in reserve capacity, greater diversity of load and operating economies.

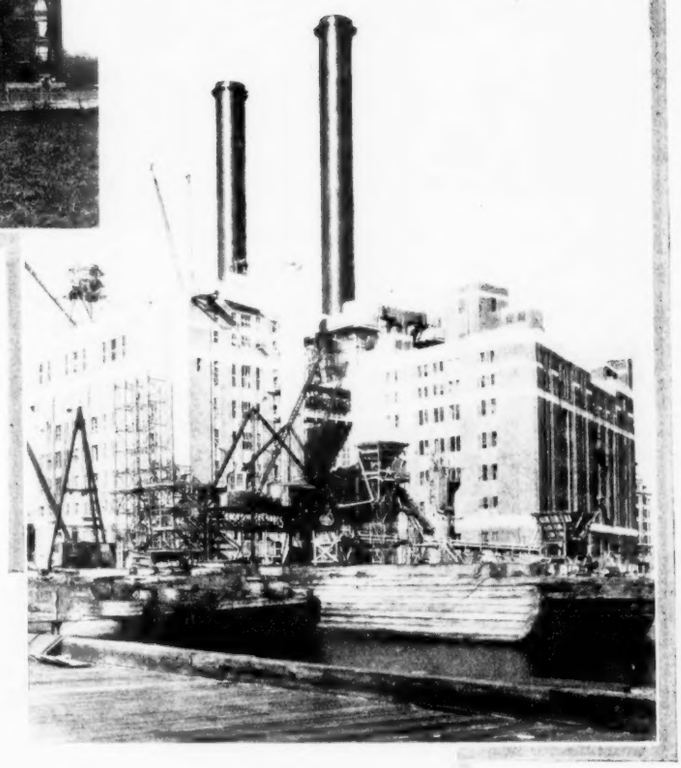
On Jan. 1, 1926, the capacity of waterwheels in plants of one hundred horsepower or more exceeded eleven million horsepower. Of the total power generated by central stations in 1925, 36 per cent was produced by water power and in the first nine months of 1926 the percentage had increased to 38. Since the enactment of the Federal Water Power Act in 1920, licenses have been issued for the development of approximately four million horsepower, and for practically one-third of this total during the last fiscal year of the Federal Water Power Commission.

Steam-Plant Economies Improving

Economies in steam plants are improving. For the year 1925 the coal per kilowatt-hour in some 4,000 public-utility plants averaged 2.1 lb. Specific plants of recent design are doing much better. The new station of the Columbia Power Company at Cincinnati is said to have run a full month at a rate of 12,600 B.t.u. per kw.-hr. At the Edgar Station in Boston, with the 1,200-lb. unit in regular service, production of a kilowatt-hour on 0.95 lb. of good bituminous coal is considered feasible, and the prediction is that this unit consumption will be reduced to 0.9 lb. upon full development of the high-pressure equipment. Other new plants are showing economies close to these remarkable results, and it is worthy of note that some of these records are being made in stoker-fired plants.

Stage bleeding, reheating of steam, higher pressures,





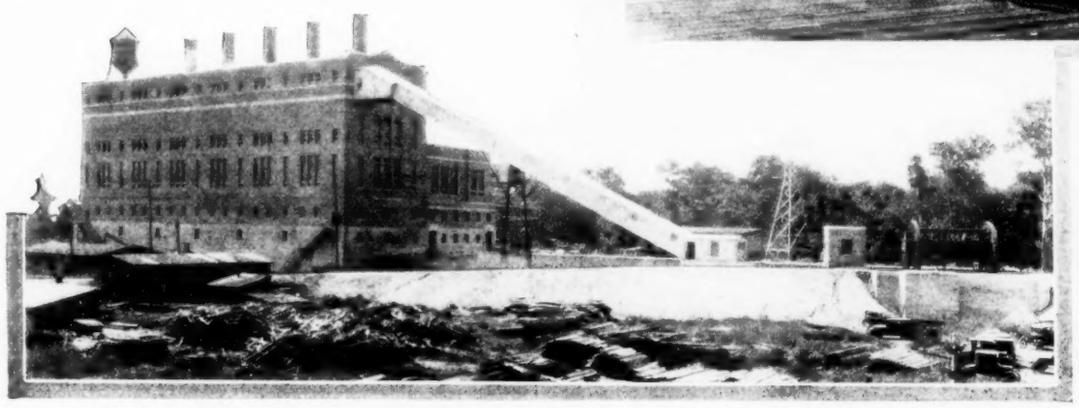
Some of the Year's New Central Stations

In the oval—Des Moines Electric Company's plant with an initial installation of 60,000 kva.

Above—Sterlington Plant, Louisiana Power Company, has 30,000 kva. installed

Right—East River Plant, New York Edison Company is installing two 60,000-kva. units

Below—Picway Station with two 30,000-kva. units installed by the Columbus Railway, Power & Light Company



economizers, air preheaters, radiant-heat absorbing surface around the furnace, turbulent mixing of the gases of combustion and other recent innovations have been vindicated. Each of these factors has contributed to the gain, and while opportunities for refinement in design and application still exist, it would seem that the present steam cycles have little more to offer. It is quite probable that in the future an upward extension of temperatures will open a new field of development in which some adaptation of the binary-vapor process may be the means of improving economies and of attaining these high temperatures safely and conveniently. It is known that the mercury-steam cycle offers certain advantages. Diphenyl oxide for the high-temperature binary fluid has been proposed, and there may be other organic compounds that would prove suitable as binary vapors.

Improvements in Mercury Boiler

During the summer of 1925 a new type of Emmet mercury boiler and a new three-stage mercury turbine were installed at the Dutch Point Station of the Hartford Electric Light Company, replacing the fire-tube type of boiler and single-stage turbine installed in 1923.

Preliminary tests during the latter part of 1925 and early 1926 showed the necessity for making several minor changes and repairs to the mercury boiler. These were made, and by the end of April, 1926, the boiler was again ready for operation. From then to the end of August the equipment carried commercial load during the day, being shut down at night and over week-ends.

During these periods of operation certain tubes seemed to heat more than others, and experiments proved that this irregularity arose from certain interference with the liquid circulation by the escape of vapor near the down circulation tubes. Improvements were adopted to prevent such interference.

Since this change was effected in the Hartford boiler, the apparatus has been operated at the highest loads that the generator is capable of carrying. The heating of all boiler tubes is apparently uniform, and everything indicates a stability of action with a very wide margin of capacity. The furnace was recently altered to burn pulverized coal, replacing the oil burners.

Higher Pressures Are in Vogue

Indicating the adoption of higher pressures, there are in operation at 550 lb. and 725 deg. F., or under construction, practically one million kilowatts of power-station capacity.

Steam temperatures considerably in excess of the present accepted limit of 750 deg. F. inadvertently have crept into the operation of some of the late stations. For appreciable periods turbines have operated with immunity at these higher temperatures. Considering these incidents, the experience gained in the operation of oil stills and the early probability of new metal combinations to withstand the service, it is quite probable that temperatures on the order of 800 deg. F., and possibly higher, may come into use in the near future.

It must not be overlooked, however, that high temperatures, and particularly a wide range of temperature over the machine, create more serious problems in turbine design than do pressures. It is the old question of high pressures versus high temperatures, with the former now in the ascendency. The 1,200- and 1,390-lb. installations at Boston and Milwaukee, respectively, are functioning with apparent satisfaction, and orders have recently been placed for two more high-pressure units for the Edgar Station to operate at 1,400 pounds.

Operation with the initial 1,200-lb. unit has proved so satisfactory that the engineers of the Edison Electric Illuminating Company of Boston, in planning for an extension of the Edgar Station, felt fully justified in taking advantage of the saving offered by high steam pressure. In fact, the detailed studies indicated that the increase in unit capacity due to the use of high-pressure steam would approximately offset the corresponding increase in cost when considered for a period of years. The saving in fuel will be, therefore, nearly a clear gain which is available through the improved efficiency of the plant.

The extension now under construction will comprise two high-pressure boilers built for 1,400 lb. working pressure and having 15,093 sq.ft. of surface, with air heaters, economizers and water-cooled furnace walls. These will supply a 10,000-kw., 3,600-r.p.m. high-pressure turbine-generator and a 65,000-kw. normal (350-lb.) pressure turbine-generator. It is expected that the boilers will supply sufficient steam to develop 10,000 kw. in the high-pressure turbine and 32,000 kw. in the normal-pressure turbine, the additional steam required by the latter being supplied by the present high-pressure and normal-pressure units.

The increase in steam pressure from 1,200 lb., as employed in the original installation, to 1,400 lb. was brought about by the desirability of maintaining the specified 1,200-lb. steam pressure at the turbine throttle while providing a more liberal margin for safety-valve setting and the operating contingencies to be expected with the variable load service.

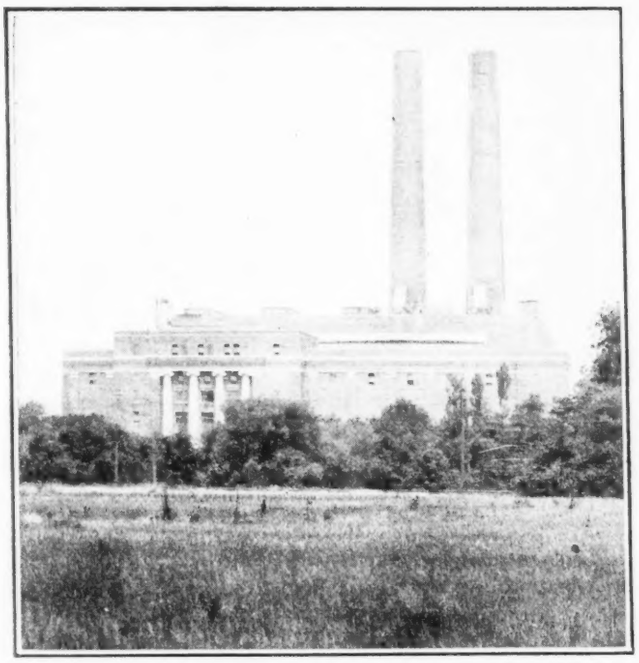
Water-Cooled Walls and Air Heaters Advance

Various definite trends in station design have developed. The advantages of water-cooled furnace walls have been definitely established. The area of steaming surface around the furnace is increasing: Side and rear walls have been protected, the water screen at the bottom of the furnace has been used for some time, and the next step under consideration is the protection of the front wall. In fact, certain furnaces have been built in which refractories have been practically eliminated. This surface may be connected into the boiler circulation or may be made independent of the boiler and connected through separate superheaters directly into the header, as in the remodeled furnace at the Fordson Plant in Detroit. Fully exposed to the radiant heat of the fire, this surface is particularly active and its use for a given capacity reduces the size of the boiler proper.

Heating feed water to high temperatures by steam bled from three or more stages of the turbine is becoming to a large extent standard. Air preheaters absorb the heat in the waste gases and to give temperatures up to 500 deg., large surfaces are being used, the areas in some cases exceeding that in the boiler four to five times.

Unit Pulverizer Mills Popular

In the powdered-coal field the unit system is gaining in popularity. Installations in the smaller plants are quite common, and in one of the larger stations of the country, recent tests have turned out so satisfactory, that future boilers are to be equipped with individual



Avon Station of the Cleveland Electric Illuminating Co.; two 35,000-kw. units installed

mills. Troubles in drying coal have resulted in new driers and drying methods. More thorough mixing of the gases of combustion by the new turbulent burners, or by tangential discharge from several burners, abetted by the protection afforded by water-cooled surface, has permitted reduction in furnace volumes.

Stokers Are Being Made Longer

Stokers are being improved and in particular made longer. With the greater effective area and the injection of preheated air over the fire, high steaming rates may be maintained efficiently at moderate rates of combustion. This is important, as getting the most out of the equipment installed is a primary factor in reducing investment.

Bleeding some of the steam from the turbine has resulted in the use of smaller condensers. All-electric drive for auxiliaries in normal operation, with certain steam reserves, is still the prevailing practice, but where variation in speed and power over a wide range is concerned, as in the case of the large forced- and induced-draft fans in some of the later stations, the excessive cost of the motor and of the control equipment is giving rise to serious consideration and a possible return to the steam-turbine-geared unit.

Automatic Control in Favor

One of the direct results of higher pressures has been a reduction in heat-storage capacity, owing to relatively smaller drums on the boilers. Being more sensitive to sudden changes in loads, boilers and auxiliaries are being equipped for automatic control. Most intricate and effective systems have been devised. By maintaining more uniform conditions and the proper relations between air and fuel supply, efficiencies have been improved.

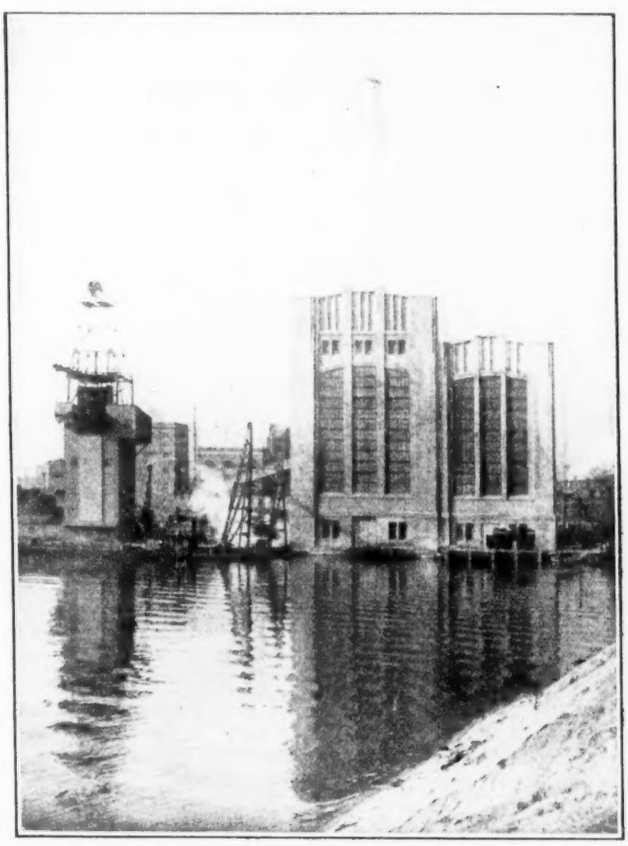
In electric substations automatic control is well established and has been extended to water-power plants of considerable size. Automatic control in refrigerating plants, involving motors of 40 to 75 hp., has been perfected, and in the heating field remote thermostatic control has been applied to unit heaters.

Tremendous Increase in Turbine Capacities

While mere size in the various units of the power plant is of no particular interest per se, the increase in unit proportions has contributed toward lowering investment and the labor item, and up to a certain point has improved efficiencies. During the year the growth in steam turbine-generator sizes has been spectacular. In quick succession orders were placed for machines of 90,000, 104,000 and 160,000 kw., and as a climax, topping all previous efforts, for a turbine-generator unit having the enormous capacity of 208,000 kw.

In other branches of the field size or capacity records have been broken. Quite recently, publicity was given to the world's largest boilers at the Beacon Street heating plant in Detroit. Two boilers, each having 41,500 sq.ft. of steam-making surface, are in service, and eventually the station is to have twelve of these units. For the development of water power two 56,000-hp. impulse turbines are being installed by the Southern California Edison Co. These wheels will exceed the present world's record for capacity in this type by 16,000 hp., this record having been established by two 40,000-hp. impulse turbines, one for installation in Brazil and the other for the Balch development on the Kings River in California.

In motors the largest yet built is a 22,500-hp. alternating-current machine weighing 110 tons and the world's largest direct-current motor of 8,000 hp. capacity for steel rolling mill operation. This machine



Gould Street Station, Consolidated Gas, Electric Light & Power Co., Baltimore, in which four 36,000-kw. units are being installed

weighs 312 tons and the outside diameter of the frame is 20 ft. Among other electrical equipment of great size is the largest auto-transformer, built for the River Station in Buffalo. It has a capacity of 66,667 kva., weighs 122 tons and stands 16 ft. 10 in. high.

Typical New Central Stations

With coal consumption reduced to a point where it represents about one-third of the cost of power up to the busbars, there has been a decided effort in certain quarters to simplify and lessen the cost of the power plant, the factor that is now responsible for about two-thirds of the power cost. This trend will be evident in some of the new modern stations of which quite a number went into operation or were projected for early construction during the year.

Of these mention should be made of the new Richmond station of the Philadelphia Electric Company, in which the initial installation consists of two 50,000-kw. turbo-generators bled from three stages, bent-tube inclined boilers with 150 per cent air heater surface and 50 per cent economizer surface in the same setting, operating at the moderate pressure of 375 lb. and equipped with underfeed stokers burning high-grade coal.

Another example of conservative engineering is the Kearny Station of the Public Service System in New Jersey. The present capacity of 185,000 kw., which is one-half the ultimate plant, is made up by five units served by twelve stoker-fired boilers, each having 23,600 sq.ft. of surface. Operating on the regenerative cycle, with steam at 340 lb. pressure and 700 deg. F. and neither air preheaters nor economizers, the plant relies for efficiency on superior operation of simple equipment. This plant, like the Richmond station, was initially started toward the end of 1925, but was not formally placed in service till 1926.

In Cleveland's new Avon plant, efficiency without complication has been the keynote of the design. Eccentricities and practices involving undue complication in proportion to the gain, were avoided in order to minimize the investment per kilowatt and overhead in the cost of operation. The initial capacity is 70,000 kw. in two units served by four 30,600-sq.ft. double Stirling-type boilers, equipped for powdered-coal burning, with economizers and air-cooled walls. The steam pressure is 400 lb. and the final temperature 725 deg. F.

Baltimore's new Gould Street Station is about ready for operation. The first of four 36,000-kw. turbines has been installed and two of the five boilers intended for the ultimate plant. In each boiler there is 26,419 sq.ft. of surface, and adding the heat-absorbing surface in the furnace gives a combined effective area of 29,069 sq.ft. Sixteen vertical burners feed the coal in powdered form into a furnace almost entirely water cooled and having a volume of 21,000 cu.ft. between the bottom water screen and the lower row of boiler tubes. The steam pressure is 450 lb. gage, and depending upon the rate of operation, the final steam temperature will range from 700 to 735 deg. F. Each boiler has nearly 100 per cent air heater surface. The design calls for a total evaporation of 530,000 lb. of steam per hour, corresponding to the gross generation of approximately 46,000 kw. and the burning of 47,800 lb. of coal per hour in the furnace.

At West Pittston, Pa., is nearing completion the Stanton Plant of the Scranton Electric Company and the Pennsylvania Power & Light Company. This plant will have an initial installation of two 40,000-kw. turbines and eight 18,600-sq.ft. boilers, to operate at 650 lb. pressure with a steam temperature of 725 deg. Chain-grate stokers for burning anthracite slush, and air preheaters will be used.

The initial installation in the new East River Plant of the New York Edison Company is nearing completion. It is laid out for an ultimate capacity of 700,000 kw. The first two units are 60,000 kw. each, operating with a steam condition of 350 lb. and 700 deg. Ten boilers, each having 15,500 sq.ft. of heating surface, equipped with economizers, water-cooled furnace walls, and pulverized-coal equipment, are being installed.

Columbus, Ohio, in its 60,000-kw. Picway station, has a new plant embodying many refinements. Longitudinal-drum boilers having more water storage and steam space than the average, are equipped with twelve-retort underfeed stokers having the unusual length of 41 tuyeres. With large grate area, capacities up to 450 per cent of rating are anticipated with little diminution in economy. Steam conditions at the turbine throttle are 335 lb. gage and 700 deg. F. Motor-driven auxiliaries, bled steam, evaporators, air preheaters and economizers are factors in the heat balance. It is of interest to point out that economizers having 65 per cent of the boiler surface absorb the heat in the flue gases and that steam bled from the turbines is used to preheat the air for combustion.

Two Large Heating Plants

In the field of heating plants there are two that may be mentioned. In the Kipps Bay Station of the New York Steam Corporation three boilers are being installed, each of a capacity of 325,000 lb. of steam per hour at 275 lb. In the boiler proper there are 10,670 sq.ft. of heating surface, and in the water walls screens and arches 4,132 sq.ft. Economizers of 10,080 sq.ft. and air preheaters of 46,800 sq.ft. area are being installed. A section through this boiler with the pulverized-coal equipment is shown in Fig. 2 under "Developments in Boilers and Boiler Auxiliaries."

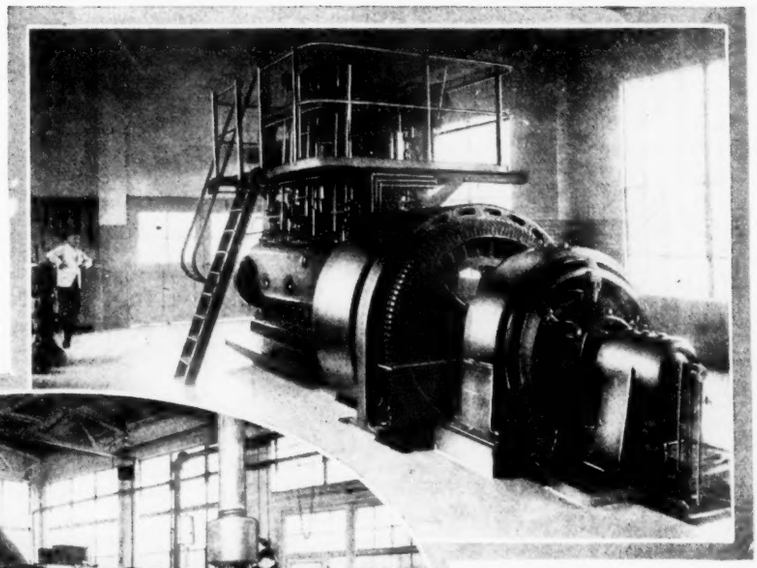
Another outstanding heating plant is the Beacon Stree[illegible] Plant of the Detroit Edison Co. This station is laid out for 12 boilers, each having 41,500 sq.ft. of heating surface; two of these units have gone into service and a third is scheduled for 1927. These boilers operate at 160 lb. pressure, are the largest so far constructed and are stoker fired. Economizers and air preheaters have been omitted, although sufficient space has been provided so that either may be installed later if economic conditions warrant their use.

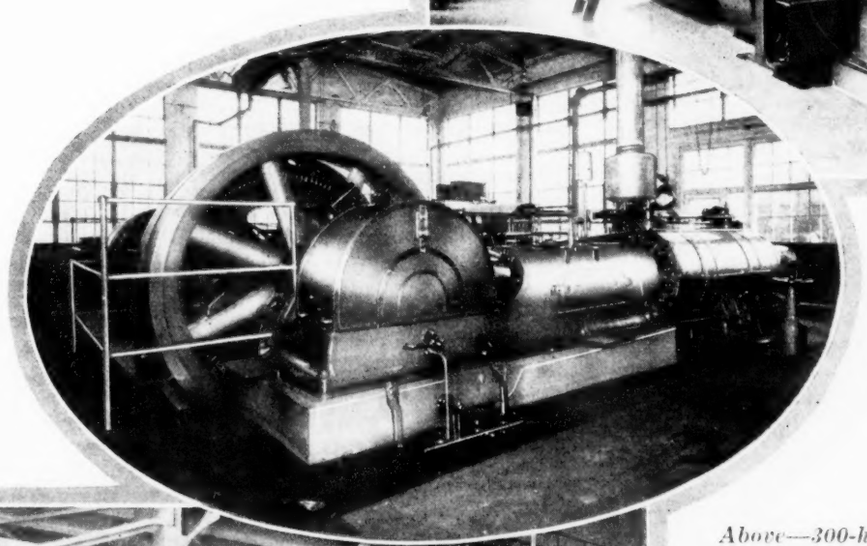
Efficiency of Industrial Plants Improving

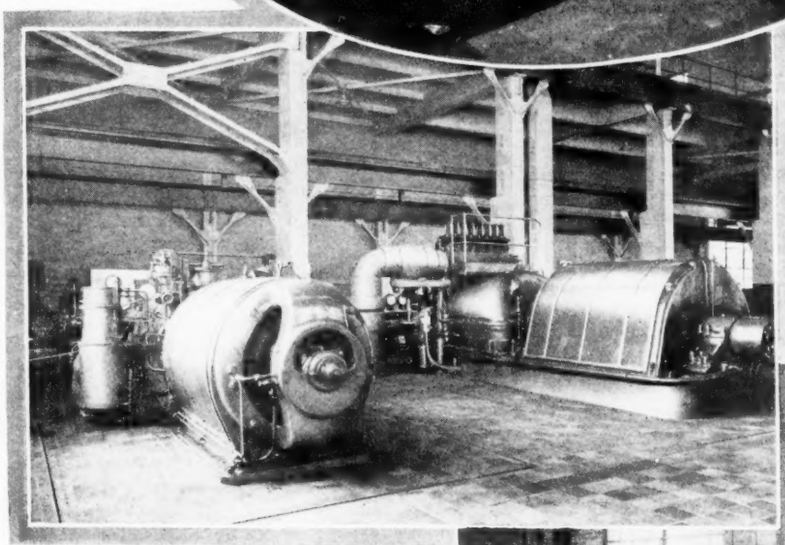
There has been a decided movement in industrial plants generally toward improving the economy of operation, through installation of improved equipment. In some cases the savings have been phenomenal. Higher steam pressures, improved firing methods, the installation of modern equipment, bleeder turbines, air preheaters and more intelligent application of process steam are some of the measures being adopted. In the paper industry the steam accumulator has been applied in a number of instances as a means of meeting fluctuating steam demands.

There has been a marked trend toward boiler pressures considerably higher than those now in general

Representative Industrial Power Plants Put into Operation During the Year

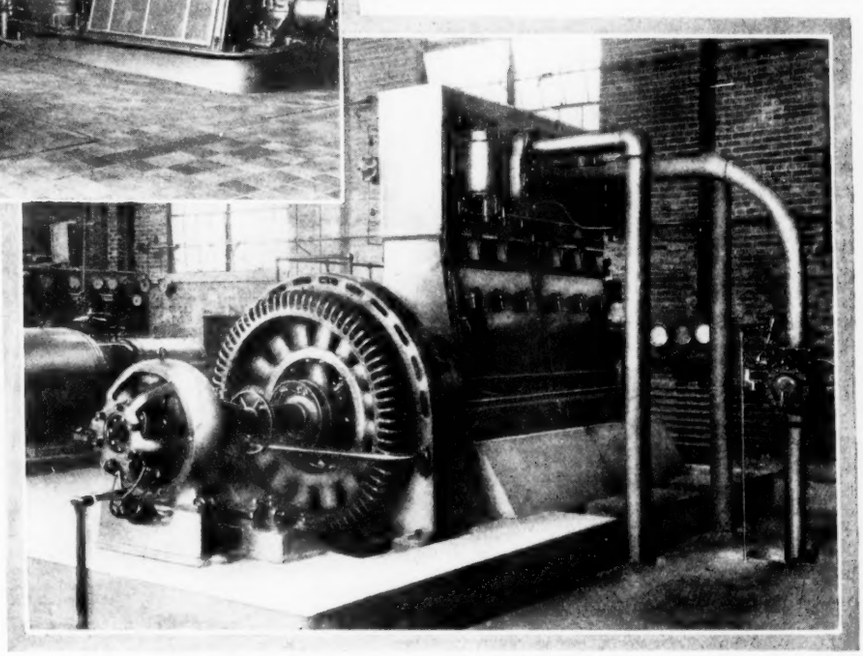






Above—300-hp. oil engine driving an alternating-current and a direct-current generator in the plant of the Avery Rock Salt Mining Co., Avery Island, La.

Oval—Uniflow engine driving an 800-kw. alternating-current generator in the Rockford Cabinet Co.'s plant, Rockford, Ill.



Above — Western Electric Co.'s power plant at Kearny, N. J., contains a 5,000-kw. condensing unit and a 1,500-kw. mixed-pressure turbine

Right—300-kw. selective-exhaust vertical steam engine in the power plant of the University of Missouri

use. From the old standards of 100 to 250 lb., pressures on the order of 300 to 450 lb. are being considered for new plants and for plant extensions. Quite a number of firms have adopted 400 lb. and one has gone to 825 lb., although it is not likely that this specific example will be followed generally until boilers and prime-mover equipment in small sizes for the higher pressures have been standardized and costs established that will not offset the possible gains.

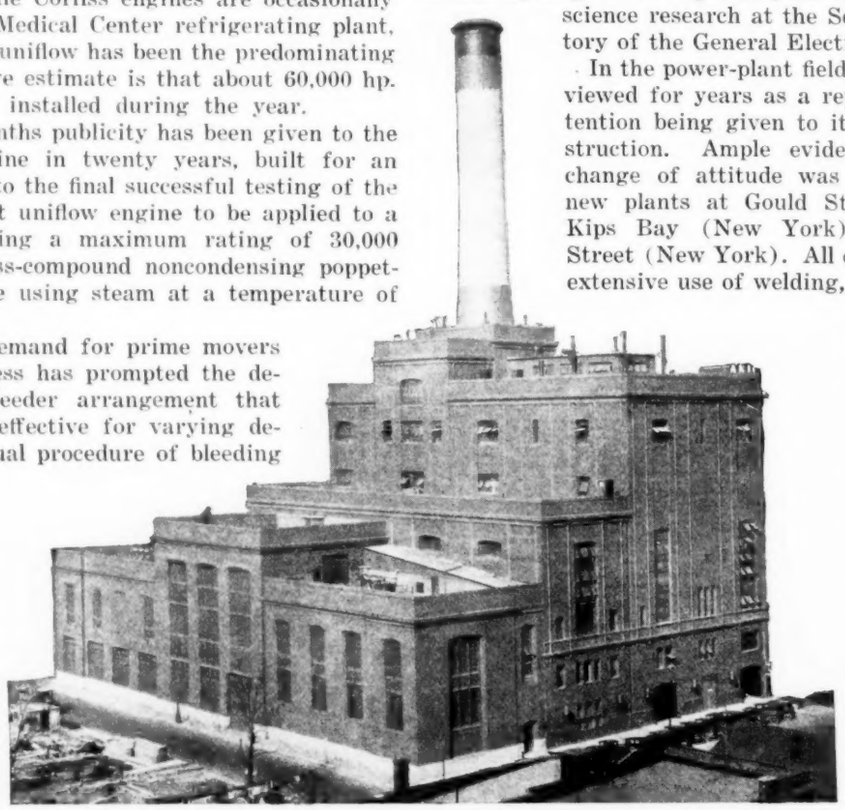
Raising the initial pressure has permitted the use of power units exhausting directly to process against relatively high back pressures, or if the demand is irregular, bleeding the steam in the quantities needed from one or more stages of the turbine, and then exhausting to the heating system or passing the balance to the condenser. The latter arrangement is, of course, not so economical, as part of the latent heat is wasted in the condenser.

Steam Engines Find Favor for Many Kinds of Service

Many different arrangements are possible for combining the power, process and heating loads, involving in some cases, mixed-pressure turbines, accumulators to smooth out small variations, bleeding from the receiver of a compound engine or from the cylinder of a uniflow engine and varied means of control. An analysis of the conditions in each plant must determine the procedure and the equipment to use. During the year numerous articles have appeared in these pages showing the enormous savings that may be made by intelligent co-ordination of the various services. Steam engines were installed in many industrial plants. This is particularly true in the Northern States and elsewhere for such plants that use considerable amounts of process steam. While Corliss engines are occasionally installed, as in the Medical Center refrigerating plant, New York City, the uniflow has been the predominating type. A conservative estimate is that about 60,000 hp. of such units were installed during the year.

Within recent months publicity has been given to the largest Corliss engine in twenty years, built for an Eastern steel mill; to the final successful testing of the largest and the first uniflow engine to be applied to a blooming mill, having a maximum rating of 30,000 i.hp.; and to a cross-compound noncondensing poppet-valve Corliss engine using steam at a temperature of 686 deg. F.

The increasing demand for prime movers exhausting to process has prompted the development of a bleeder arrangement that would prove more effective for varying demands than the usual procedure of bleeding the receiver of a compound engine. This new development applied to a vertical uniflow engine, consists of pressure-actuated valves controlling the amount of exhaust steam going to process and that to the condenser, much in the same way as the division is made in a bleeder turbine. Another innovation is the introduction of an eductor exhaust which should prove particularly effective on heavy loads and, by offsetting the drop in efficiency due to late cutoff, permit a higher rating for the engine. This is still more or less in the development stage.



Beacon Street steam plant, Detroit Edison Co., has two 41,500-sq.ft. boilers in operation; ultimately there will be twelve units

New Things in Refrigeration

In the refrigerating field compression pockets are being used to give flexibility to the ammonia compressor, so that it may conform efficiently to the changes in temperature of can water and ammonia during the different seasons of the year. Extended tests on evaporating equipment have resulted in the design of coils having a heat transfer up to 175 B.t.u. per square foot, as compared to 15 to 20 B.t.u. obtained in the average plant.

One of the outstanding developments of the day, which has given the absorption refrigerating system a new lease of life is the new Platen-Munters pumpless system given recent publicity in these pages.

An interesting trend is the growth of welding in plant construction and its application to a great variety of repair work in the daily routine. Smoke abatement has been a live subject during the year. Several cities have appropriated large sums to organize and carry on the work, and a revival of interest generally in all sections of the country has been evident.

Progress in Fusion Welding

The art of fusion welding has made marked progress during the year. While most of the advances consisted of extension of applications and the refinement of existing processes, a notable scientific contribution was the atomic hydrogen welding torch, an outgrowth of pure-science research at the Schenectady laboratory of the General Electric Company.

In the power-plant field, welding has been viewed for years as a repair tool, little attention being given to its use in new construction. Ample evidence of a marked change of attitude was afforded by such new plants at Gould Street (Baltimore), Kips Bay (New York) and Fourteenth Street (New York). All of these have made extensive use of welding, some of the applications being piping (steam, water, atmospheric relief), stacks, tanks, fin tubes, seal welding (on furnace casings, breechings, economizers, pulverized coal bunkers, etc.), air ducts, and heaters, etc. The welding of structural steel is a relatively new development and may possibly become of importance in power-plant construction.

Developments in Boilers and Boiler Auxiliaries

INCREASING use is being made of radiant surface in steam boilers with water-cooled furnace walls and air preheating is gaining favor. For the time being, high pressures have ascendancy over high temperatures. Developments in industrial plants show trend toward pressures and temperature comparable with central-station practice.

IN BOILER development the trend is still toward larger units, higher pressures, designs exposing the maximum surface to the radiant heat of the fire, operation at high ratings to reduce plant investment, and quite generally for the same purpose elimination of refinements that appear to involve more complication than is warranted by the gain in efficiency they afford.

It has been found that heat transfer by radiant heat may result in the absorption of 70,000 B.t.u. per hour per square foot of exposed surface, corresponding to operation at 2,100 per cent of rating, or the evaporation of about 63 lb. of water per hour per unit of surface. This is probably the upper limit of commercial heat transfer of the most active surface. The average for the entire boiler naturally does not approach such a figure, owing to less favorable location and the restrictions imposed by feedwater characteristics. Boilers are being installed to operate continuously at 500 to 600 per cent of rating, and it is considered quite feasible to go higher.

High rates of combustion have been made possible by surrounding the furnace with steam-making surface, using a relatively small boiler with much of the surface exposed to the radiant heat, and transferring the less active convection surface to a counterflow economizer where conditions for heat transfer are more favorable. Back of the economizer may be an air preheater, and the trend is to encase the entire equipment in one setting or at least arrange it compactly with short gas travel from one element to the other. One of the much heralded test installations of the Commonwealth Edison Company at the Calumet Station in Chicago follows the foregoing arrangement. At this writing it is ready to function, and the tests that are to come will go a long way in determining the relative advantages of powdered-coal equipment and stokers for the inferior Illinois coal burned by the company.

A design of boiler giving full play to modern trends is the new Combustion Steam Generator, announced about a year ago. In this the boiler surrounds the furnace, so that practically the entire heating surface is exposed to the radiant heat of the fire. The design eliminates refractories and requires a comparatively small surface for a given output. Highly preheated air is depended upon to maintain furnace temperatures and ignition. Contracts have been taken for a number of these generators, and as the first of these installations are only nearing completion, no information is available on performance.

Two of these generators equipped with air heaters and unit pulverizers, going into the new plant of the Solvay Process Company at Syracuse, N. Y., will generate steam at 825 lb. gage pressure for two 5,000-kw. turbo-generators operating against a back pressure of 165 lb. gage for process work.

A new steam generator in which the tubes completely surround the furnace in "birdcage" fashion, is shown in the course of erection in Fig. 1. This was designed by C. W. Burroughs, chief engineer of the Canada Sugar Refining Company, Ltd. One such unit has been in successful operation for several months, and a second is now being installed. The arrangement is such that the powdered fuel is introduced through the center of the top drum, so that all the tubes are subjected to like conditions. A corresponding opening in the bottom drum provides accessibility to the interior of the generator for cleaning, etc. Air is introduced tangentially,

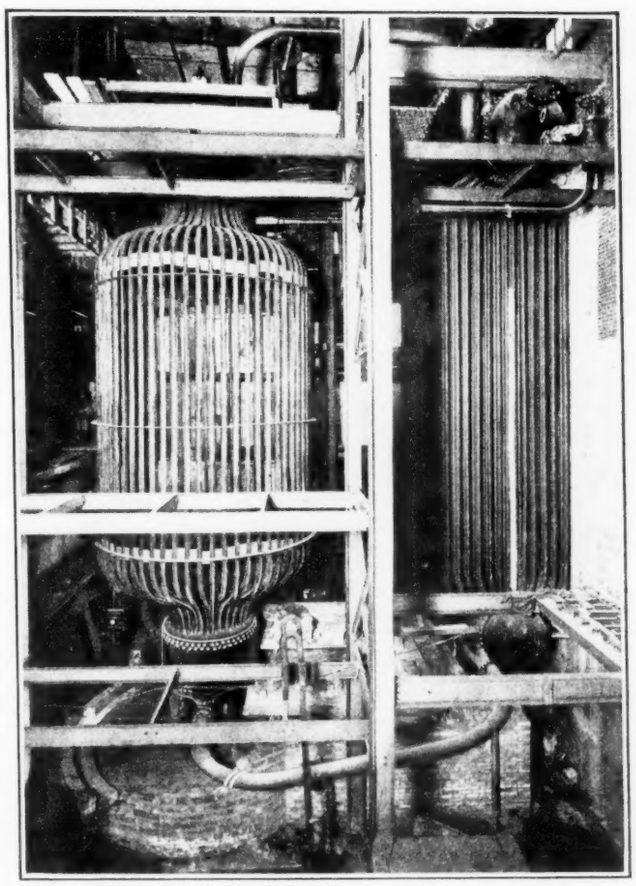


Fig. 1—Steam generator being installed at plant of Canada Sugar Refining Company, Ltd., Montreal

both clockwise and counterclockwise through passages in the surrounding brickwork, thus providing the necessary turbulence. The arrangement of tubes and brickwork is such that the backs of the former receive the reflected heat from the furnace and in this way also maintain the refractory in a relatively cool condition.

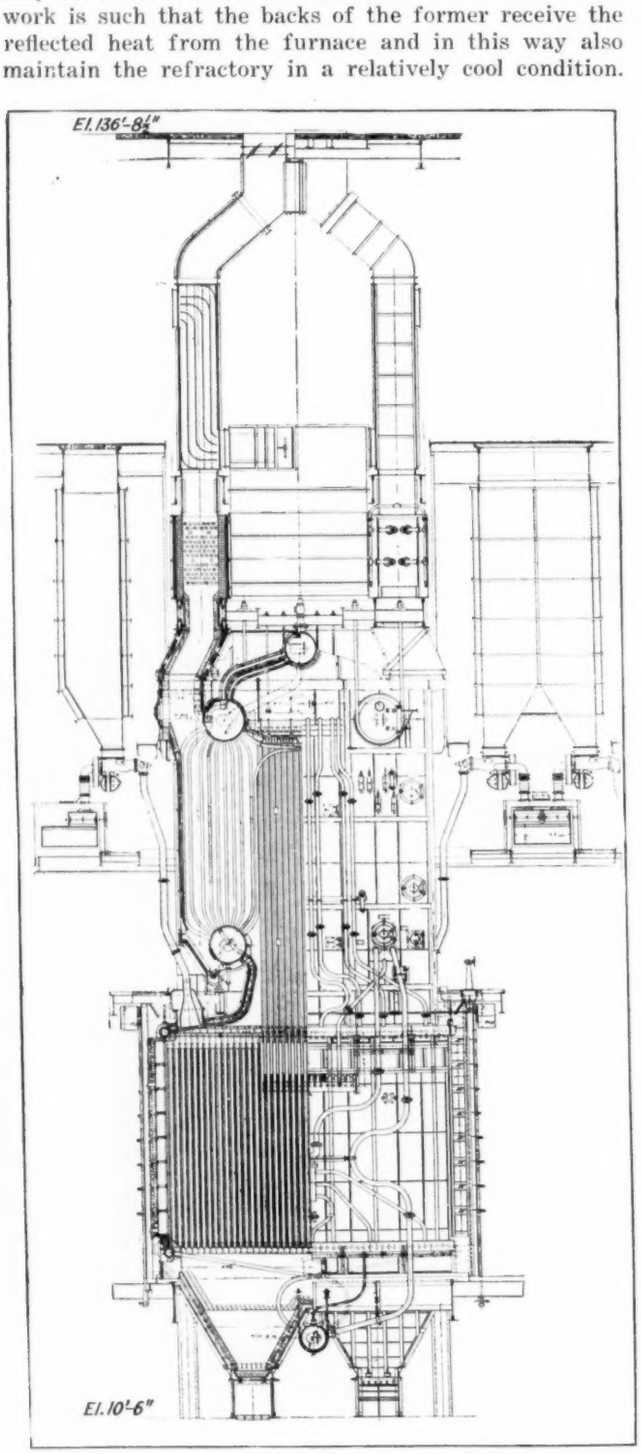


Fig. 2—Section through one of the three boilers being installed in the new plant of the New York Steam Corporation

Note that from the basement floor to the blower floor the height is 126 ft., including furnace, boiler, economizers and preheaters.

A separate economizer section is provided and forms a part of the circulation system of the boiler. This section contains the superheater. A detailed description of the generator will appear shortly in *Power*.

As to the effectiveness of radiant surface in the furnace, an apt illustration is the recent remodeling done at the Fordson Plant, where the addition of 2,230 sq.ft. in side-wall and water-screen surface to the 26,470 sq.ft. already in the boiler, doubled the steam output without adding to the floor space. The changes that made possible this remarkable increase in steaming capacity are surprisingly simple. Air preheated to 500 deg. F. accelerated combustion, twelve more burners furnished the additional fuel, larger fans met the new demands for air and gas movement and automatic control insured maximum extraction of heat from the coal. A somewhat similar installation is that being made in the Kipps Bay station of the New York Steam Corporation, which consists of three boilers, one of which is shown in Fig. 2, and already referred to on page 6.

Approaching the problem from another angle, the recent proposal to carry on combustion in two stages at temperatures suitable for the usual refractories is of interest. One-half the fuel, preferably in pulverized form, is to be burned in the first combustion chamber, the products of combustion passing through the first section of the boiler and into a second combustion chamber, where the remaining fuel is added and the flame temperature is again brought up to the desired point. With the initial products of combustion from the first stage deficient in oxygen it is probable that violent turbulence would be required for complete and rapid combustion in the second stage. The gases then pass over the remaining boiler surface and at relatively high temperatures enter a large air preheater. Primarily, this plan is offered as a means to enable highly preheated air to be used in ordinary furnaces.

A radical departure in design is the La Mont steam generator, Fig. 3. Although the first commercial generator was designed for waste-heat service, the boiler, owing to its small tubes and separating drum, is adaptable for primary service for pressures up to 1,200 lb. and higher. The principle involved is that of injecting an excess of water into the top of a number of long 3-in. tubes so that the water forms a film on the interior of the tubes. Only part of the water is evaporated into steam, so that the remainder, together with the steam formed, passes from the lower ends of the tubes into a header and thence to a separating drum, where the steam is liberated and the water recirculated to the top of the tubes. A large number of these small vertical tubes are expanded into headers top and bottom and are staggered to permit close spacing. The straight upflow of the gases in a single pass over the surface is conducive to high gas velocity and good heat transfer.

In boilers for high pressure, one of the latest developments is the large Lakeside unit, which within the last two months has reported successful operation at 1,350 lb. It may be recalled that the boiler is of special three-drum Stirling design with 28,532 sq.ft. of surface in 3-in. tubes. Drums of forged steel 5 in. thick, 40 in. inside diameter and approximately 40 ft. long accommodate a unit width of 70 tubes. To raise the steam temperature to 720 deg. F., radiant superheaters line the side walls of the furnace and a radiant resuperheater on the back wall raises the temperature of the steam exhausted from a 7,000-kw. turbine at 317-lb. gage and a temperature of 447 deg. before its delivery to the main steam header of the plant. The arch of the furnace and the front boiler wall are water-cooled and a water screen protects the furnace bottom.

Gases from the boiler pass downward through two

air heaters of plate type having an aggregate of 40,320 sq.ft. of surface, to heat the air for combustion to 650 deg. F. when the boiler is operating at maximum load. In the comparatively short time the boiler has been in service, there seems to be nothing to fear in the way of operating difficulties.

Some Foreign High-Pressure Units

Attempts to avoid various difficulties of high-pressure steam generation have led to ingenious arrangements, some of which may prove of permanent value. There is now nearing completion at the Witkowitz Coal Mines (Moravia) an 18,000-kw. plant in which steam at 1,500 to 1,700 lb. will be supplied by a "fireless" boiler. This is an outgrowth of Doctor Loffler's experimental installation at the Vienna Locomotive Works.

In the Loffler steam generator, superheated steam is delivered by a pump to nozzles which bubble it through water in a heavy drum. The superheat evaporates some of the water, so that a weight of saturated steam leaves the boiler greater than that of the superheated steam supplied. A weight of saturated steam, equal to that of superheated steam delivered, is pumped back through the superheater, the excess being available for outside consumption. The "boiler" setting contains only a superheater and economizer.

This construction makes possible a lighter drum by eliminating tube holes. Scale production in the generator cannot affect safety or efficiency. On the other hand, new problems of pumping and superheater operation are introduced.

Another high-pressure German boiler has primary and secondary systems. The former is closed and therefore not subject to difficulty from impure water. Part of the primary system is a coil lying in the drum of the secondary system. Condensation of the primary steam in this coil generates the secondary steam from pure or impure water.

A third arrangement is that developed by Sulzer Brothers, of Winterthur, Switzerland. An experimental installation has been constructed with low- and high-pressure boilers in the same setting, the two pressures being around 200 and 1,500 lb. The low-pressure boiler preheats the high-pressure feed and supplies distilled makeup to the high-pressure boiler.

Temperatures and Pressures

Up to this time engineers have not considered it advisable to employ steam temperatures in excess of 750 deg. F., although there have been numerous occasions where this temperature has been exceeded with impunity for considerable periods of time. One particular case given considerable publicity was the Gennevilliers plant in Paris. Recent tests made in Washington on low-carbon steels indicate that they may prove satisfactory under high temperatures if low unit stresses are used. Fatigue tests made in England on steels at various temperatures indicate that the fatigue limit does not decrease appreciably at high temperatures below that at normal temperatures. This would seem to indicate that a part designed within the safe flow limits at high temperatures would be within the fatigue limit as well. Other experiments with special alloy steels are only a few of the many indications that the step to higher temperatures may be made in the near future.

According to a recent report the high-pressure addition to the Langerbrugge Station, near Ghent, Belgium, which has been in operation for about a year, has shown a 33 per cent saving over the older section of the plant, the relative heat consumption per kilowatt-hour being in the neighborhood of 23,000 and 15,000 B.t.u. respectively. It will be recalled that the new section of the plant operates at 710 lb. pressure and 840 deg. F. at the turbine throttle.

High Pressures in Industrial Plants

While much of the foregoing has been representative of development in the larger stations, there is a marked trend toward increased pressures in industrial plants,

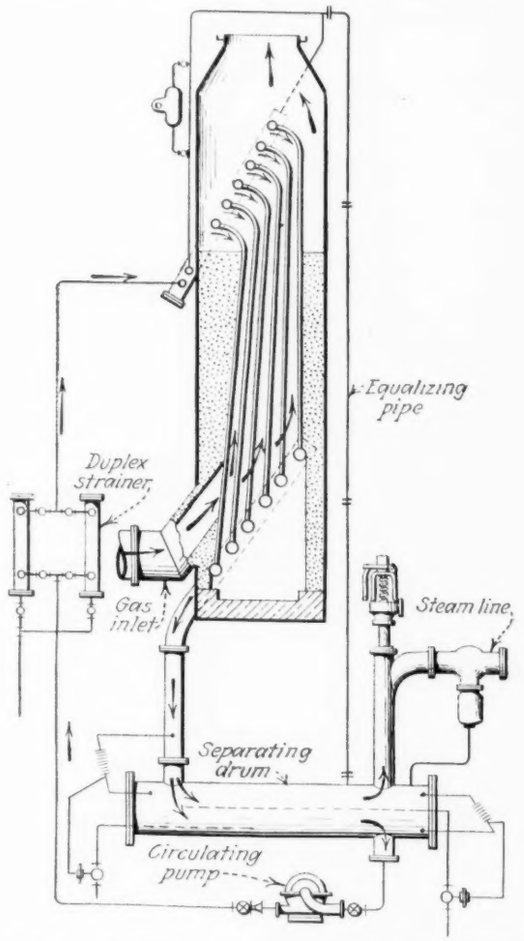


Fig. 3—Diagram of single-pass La Mont boiler

especially those employing steam for process. By installing a high-pressure generating unit exhausting to the existing station header or to process or bleeding at a relatively high pressure, the necessity for using live steam is largely obviated and increased economy is obtained. A number of the larger industrial plants are installing boilers up to 15,000 sq.ft. of surface, and integral economizers, air preheaters, ventilated and water-cooled walls are becoming the usual thing.

Even pressures of 400 to 450 lb. are considerably in excess of former practice, and this demand for higher-pressure boilers necessarily has required a number of changes in the manufacturing process to insure a product that will be thoroughly safe and reliable. Higher pressures demand heavier materials and more exacting work in fabrication, requiring the introduction of special machine tools in an art where they never had been used before. For example, Fig. 4 shows a flange that has been machined in the boring mill, rivet holes that

have been drilled from the solid metal and the inside calking edge of the flange which has been beveled properly on the boring mill. In Fig. 5 is shown the drum into which this head will be fitted. To reduce the number of joints to a minimum, the drum is made from a single plate, and again there is evidence of machined surfaces on the edge of the plate and on the edges of the inside and outside butt straps.

Many Applications of Waste Heat and Electric Boilers

During the year a number of installations have been made of the new B. & W. waste-heat boiler, shown in Fig. 6. This boiler has been developed for cases where there is dust in the waste gases, making exceptional facility for tube cleaning necessary and where it is particularly desirable to have minimum draft loss with maximum heating surface in the space available. It will be apparent that the boiler requires considerable headroom.

A most unusual steam plant placed in operation about a year ago is the electric-boiler steam-accumulator installation at the Riverbend (Quebec) newsprint mill of Price Bros. & Co. Steam generated by two 32,000-kw. electric boilers is supplied to process at two pressures, 150 and 25 lb., kept constant by sensitive governor valves regardless of the load.[1] One of the first high-pressure steam accumulators installed on this side of the Atlantic, floats on the line between the two governor valves and absorbs or delivers the difference between the steam passing the high-pressure valve and the demand for low-pressure process steam.

In this country and Canada there are installed over 750,000 kw. of these boilers. The manufacturers of the Kaelin type in Canada, report a total rated capacity of 563,000 kw. As these boilers have an overload capacity up to 50 per cent of their rating, the actual capacity is much higher. During the last year this company has

Fig. 4—Boiler head showing planed surface and drilled rivet holes

installed over 200,000-kw. capacity which includes three units, each of 42,000 kw. at 6,600 volts.

With the modern boiler, experience and results obtained have carried the use of water-cooled surface in the furnace past the experimental stage and established this innovation as one of the most desirable features in boiler construction. Plain tubes and tubes protected by various designs of iron block, bare or covered by a thin layer of refractory, are being used and in other furnaces fin extensions to the tubes, brought in contact with adjacent fins, present practically an entire metal surface. Some difference of opinion exists as to the percentage of refractory that may be needed to maintain furnace temperatures and ignition. This is a question that hinges upon the character of the coal, the degree of preheat and, in the case of powdered coal, the fineness of grinding and the provision for turbulent mixing, so that the problem is distinctive for each plant and must be solved in accordance with existing conditions.

Equalizing Gas Flow to Superheater

In superheaters no radical changes have been reported other than the modifications necessary to adapt them to high pressures and high temperatures. Loca-

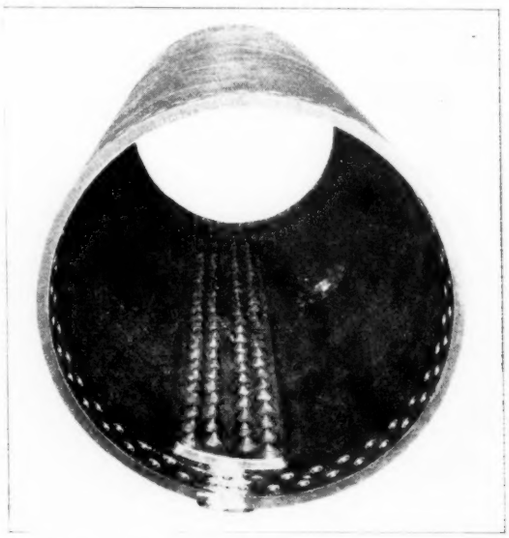


Fig. 5—Drum from single plate in which edges of plate and straps have been machined

tions are of course nearer the fire. Convection superheaters are placed between tube decks or in the front bank of tubes and radiant superheaters at various locations in the furnace with protection afforded by the water-cooling tubes or other means.

In many instances, with horizontal water-tube boilers, the convection superheater is above the fourth row of tubes. For boilers fired with pulverized fuel, with walls of water-cooled tubes, it has been necessary to reduce even further the number of tubes below the superheater, particularly near the furnace side walls. As a case in point the six 16,000-sq.ft. boilers installed at the new East River Station of the New York Edison Co. have four 3-in. tubes below the superheater, at the center of the boiler. Proceeding toward the sides of the boiler, this number is reduced to three and then to two tubes, as indicated in the cross-section of the boiler, Fig. 7.

With this arrangement of tubes in the lower bank the temperature of the gases is uniform over all superheater elements and the performance of the boiler is favorably affected. It is a well-known fact that the gas velocity is greater at the center of a furnace than at its side. Reducing resistance to the gas flow by eliminating tubes at the sides of the furnace tends to equalize the flow of the gases over the entire area.

The recent tendency to use advanced steam pressures and temperatures in additions to older plants has created a condition calling for desuperheating when it is desired to supplement the steam supply in the older

[1] See Nov. 9, 1926 issue, pp. 688-92.

section of the plant without first passing the high-temperature steam through a prime mover. For this purpose a new closed type of U-tube desuperheater, in which no water comes in contact with the steam, has been devised, and for the purpose previously indicated is used in conjunction with a reducing valve in the tie line between the two sections of the plant. As better heat transfer can be obtained between boiling water and steam than with cold water, the desuperheater is connected to both the steam and water spaces of the boiler, although owing to the greater temperature difference, the water is taken preferably from the low-temperature boiler and, as evaporated by the high-pressure steam within the desuperheater tubes, is returned to the same boiler.

A desuperheater based on this principle has been built by the Superheater Co. for the Hudson Avenue Station of the Brooklyn Edison Company[2], where a new 80,000-kw. turbine, supplied by four 400-lb. pressure boilers, was installed. In emergency cases the steam from the new boilers, generated at 400-lb. pressure and 725 deg. F., can be used in the older section of the plant by passing it through the desuperheater and a reducing valve to obtain the required steam conditions of 280 lb. and 630 deg. F.

Preheating Air to 500 Deg.

Experience with the air preheater is developing, and its use even in the smaller plants is becoming more general. Better combustion and reduced flue-gas temperatures are the benefits, which from data available are paying good dividends on the cost of installation, operation and

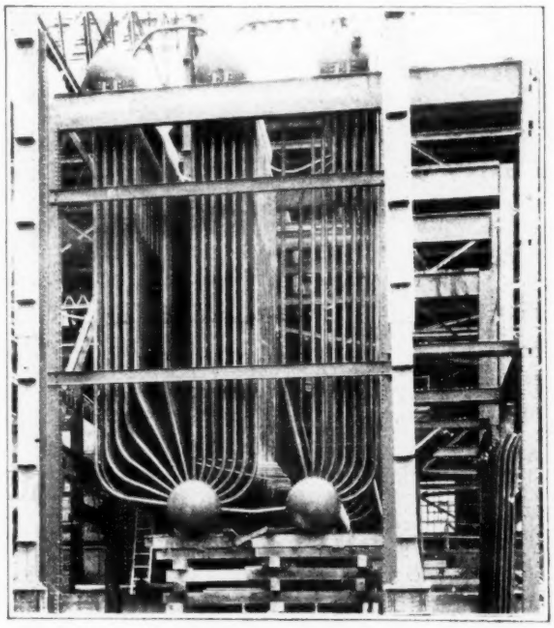


Fig. 6—New type of waste-heat boiler adapted for use with dusty gas

maintenance. Fears expressed originally that the heated air would burn stoker parts and destroy the brickwork have been allayed, as indications are that within certain limits the heated air reduces stoker and refractory maintenance, owing to the cleaner fires resulting from improved combustion. With powdered coal, protection is afforded by water-cooled walls, so there has been little hesitancy in increasing the preheat temperature to 500 deg. and in specific cases to a higher temperature. Naturally, this upward swing in temperatures calls for large preheaters, and surfaces ranging from 100 up to nearly 500 per cent of that contained in the boiler are being used.

[2]See *Power*, Nov. 30, 1926, p. 803.

Feed-Water Treatment

In feed-water treatment, there seems to have been no outstanding development during 1926. This does not mean, however, that there has been no activity in this

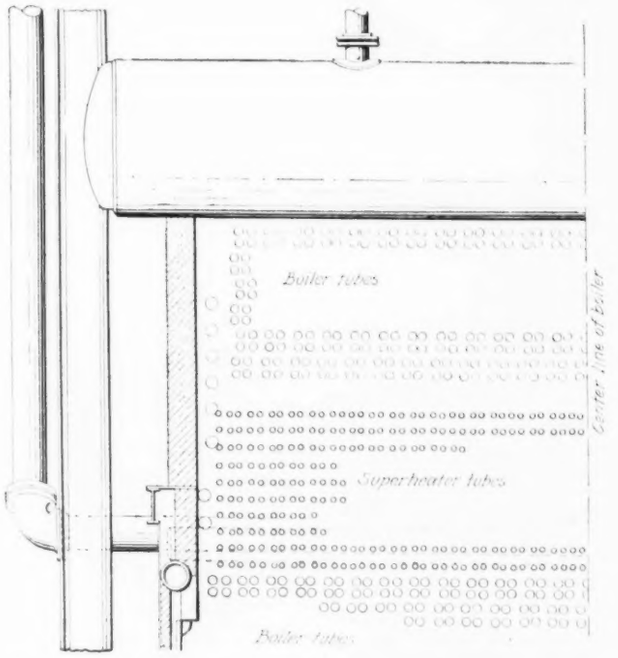


Fig. 7—Tubes at sides of boiler omitted to give uniform gas flow

field. Operation at high pressures and high ratings has made the requirements so much more exacting that most extensive programs of research on the treatment and conditioning of boiler feed water to prevent scale, foaming and priming, corrosion, embrittlement of boiler steel and other kindred troubles are being conducted, and in the larger plants close attention is being given to the various methods of treating water now in vogue. Deaërators and evaporators are being improved and care taken to minimize condenser leakage so that scale-forming and soluble salts may not enter the boiler in excessive quantities.

Automatic Combustion Control

Millions of square feet of boiler heating surface already are under full automatic combustion control, and the movement is gaining momentum. To the variety of automatic systems already in service, a number of new developments varying in detail and method of operation have been brought out during the year.

An attempt has been made to relieve the water level regulator of caring for the fluctuations in pressure differential between the boiler drum and the feed line—by the insertion of a differential pressure regulator, not at the pump or the header, as has been the practice in the past, but in the feed line to each boiler. Tests conducted last summer at the Crawford Avenue Station indicated that practically ideal conditions could be maintained under such a combination of pressure and feed control.

Production of Fuels and Their Utilization

COAL and oil production are at a high figure. Interest in the processing of coal is increasing. Water-cooled walls, smaller furnaces, unit mills, turbulent burners and improved driers are features in the powdered-coal field. Longer stokers of improved design give high efficiency over a wide range of load.

NO ONE event of the year holds greater significance than the recent International Conference on Bituminous Coal at Pittsburgh. Engineers from all over the world were present to discuss new uses for bituminous coal and its more economical utilization through various processes of carbonization, with the recovery and use of byproducts, solid, liquid and gaseous, and the complete gasification and production of synthetic products. From the conservation point of view the continued burning of raw coal is an extravagance. The way is open to complete chemicalization, but the undertaking is costly and with the great supply of fuel still remaining in this country, the incentive here has not been urgent. It is probable that a number of years will elapse before any substantial proportion of the total tonnage mined will be processed before being burned, excluding, of course, the high-temperature distillation of coal for the production of city gas and metallurgical coke.

United States Coal Supply

At the conference the senior geologist of the United States Geological Survey, R. Campbell, placed the total remaining coal supply of the United States at 3,419 billion tons. The amount recovered so far, including the mining waste, represented a depletion of 25 billion tons. The United States has practically one-half of the entire world's coal resources. However, while there is no immediate anxiety regarding the supply, this does not relieve us of intelligent conservation, particularly as the high-grade coal is but a small fraction of the total reserve. Estimates from another source, made public about a year ago, credited the billions of tons remaining as follows: 17 for anthracite; 1,510 for bituminous coal and 2,000 for lignite. The percentages that had been used were respectively, fifteen, one and practically none. These figures emphasize the importance of studying the use of the low-grade fuels, sub-bituminous and lignite, forming the great bulk of the reserve.

Status of Coal Industry

In the coal industry, which is greatly overmanned and has a potential producing power far in advance of any possible needs, demoralization best expresses the present status. The strife between unionized and non-unionized fields continues, with the latter gaining the ascendancy, owing to the lower wage scale and the greater flexibility of non-union labor. On March 31, this year, the Jacksonville wage agreement with the union bituminous fields expires and the negotiations of a new compact within the next few weeks may add to the disturbances already existing.

As a sidelight on hand versus mechanical loading, it has been estimated that if the men actually employed, worked 300 days per year, 244,000 could produce all the coal needed. Assuming further that the uneconomic mines were abandoned and an average of 12.5 tons were produced per man per day, the number of men required would be reduced to 147,000. At the present time, about 700,000 men work on and off in the coal mines and are classified as miners.

It is evident that the coal business must be completely reorganized along the lines of modern industry before conditions can materially improve. Some of the essentials are mechanization of the mines, stabilization of output in accordance with the demand, the shutting down of uneconomical mines, and the reduction of the operating force to a point where each miner will have continuous work and a commensurate wage. Mergers of some magnitude already have been effected ostensibly with these ends in view.

Coal Production

Except for the latter half of the year, bituminous coal prices have been at a low level. Industry is buying more and more of its coal from the low-cost non-union mines. Union mines in Pennsylvania and Ohio have been fighting a losing battle. For years Pennsylvania has led in the production of soft coal. In 1926 West Virginia, with an output usually less than one-half that of Pennsylvania, is likely to carry off the honors. Eastern Kentucky is shipping great volumes of coal northward and non-union Western Kentucky with its many fields of excellent quality has been competing most actively with Illinois mine fields.

With a bituminous output averaging about 8.5 million tons per week for the first two months of the coal year, the production gradually increased, owing to a well maintained demand from home industries and a growing foreign market originating with the British strike, until it reached during the week ending Dec. 4 a new high mark for all time, a weekly output estimated by the United States Bureau of mines at 14,676,000 net tons. With the recent settlement of the British strike there was some recession, but it is probable that the final figures for the year will reach or exceed the records made in 1923 and 1920, when the tonnages were, respectively, 564,565,000 and 568,667,000. In 1925 the recorded production was 522,967,000 tons. By Dec. 18 the 1926 figures reached 557,490,000 tons.

In the anthracite field the settlement early in the year of the longest strike in the history of the industry was perhaps the most notable event. By Dec. 18 production had reached 82,373,000 tons, and it is probable that the total for the year approximated 85,000,000 tons. This is below normal and may be explained partly by

the continued use of the substitute domestic fuels introduced during the strike, particularly coke and low-volatile bituminous coals.

Crude Oil Production

From a prolonged and burdensome period of overproduction of crude oil, the petroleum industry has passed into a position of slight excess of consumption over production. Although at the present writing, crude oil output is running at a new high record, estimates made late in December indicate a United States production of crude petroleum during 1926 practically equaling the 763,000,000 bbl. record production of 1925. Consumption of petroleum increased slightly, so that the net result has been a decrease in the stock of crude, the estimated decline being from 338,500,000 bbl. on Dec. 31, 1925, to about 300,000,000 bbl. on Dec. 31, 1926.

The Federal Oil Conservation Board, after nineteen months of investigation, recommended a far-reaching plan of protection calling for co-operation between the oil-producing states and the Federal Government, between the states themselves and between the oil operators. It found that current supplies were ample and that there was actually in sight a reserve of 4½ billion barrels, a quantity probably greater than has been in sight at any one time before, and amounting to more than 50 per cent of the total past production of petroleum. On the whole, however, the Board report was pessimistic regarding petroleum reserves. This pessimism is not shared by W. S. Parish, president of the American Petroleum Institute, whose present concern is that we may again suffer from overproduction.

Processing of Coal

No better indication of the present experimental activity in the field of coal processing could be found than at the International Conference on Bituminous Coal given earlier mention. Technical papers were presented covering coal supplies, fundamental research in high-temperature and low-temperature carbonization, development of byproducts, the production of methanol (wood alcohol) and synthetic petroleum, gas manufacture, power production, coal tar and fertilizer, smoke prevention, artificial domestic fuels, etc.

These subjects are all of direct or indirect interest to power engineers, because the coal-treatment problem cannot be successfully attacked without running into various related fields. It seems probable on the basis of some of the facts brought out that the future may see combinations of gas works, power plants, oil refineries and domestic-fuel factories as intimately tied together by mutual use of energy and material byproducts as are the parts of a present-day power station.

However, the field is so immense that it will be necessary to confine the discussion here mainly to the subject of low-temperature carbonization, which is the phase of coal processing of most immediate interest to power-plant engineers. As compared with high-temperature distillation now used in city gas works and byproduct ovens for the production of metallurgical coke, low-temperature carbonization yields much less gas but more oil and coke with greater possibilities as a domestic fuel.

Interest in this subject has been live for several years both in this country and abroad. In the United States the backing of low-temperature carbonization experiments has come mainly from commercial sources which have hoped to produce a total value in domestic fuel, gas, oil and other products exceeding that of the raw coal and the cost of processing it. Here, as in England, the domestic-fuel product is in most cases looked upon as the greatest source of revenue, with enough from the other sources to make the process pay. An exception is the McEwen-Runge experimental plant.

No low-temperature process yet tried in this country has fully demonstrated its capacity to pay dividends, with the present market for byproducts. Several, however, are operating well mechanically and are said to be close to the profit line—so close, in fact, as to give hope that the not-distant future may see low-temperature carbonization on an established business basis. It must be pointed out that not all who have studied this field would subscribe to this optimistic statement. Many competent engineers feel that years must pass before economic conditions are ripe for the general use of low-temperature carbonization.

Professor Parr, of the University of Illinois, reports technical success in the low-temperature distillation of mid-continent coals. He does this in two stages in retorts.

Last year's report made mention of the McIntire-process installation at the Consolidation Coal Products Company plant at Fairmont, W. Va., and the McEwen-Runge installation at the Lakeside power station, Milwaukee. The former process, in which coke products from a low-temperature retort are briquetted and then given a slight secondary carbonization, has been in operation for two years. About 22,000 tons of coal has been given the primary carbonization. The briquetting plant, which has been in operation since June, 1925, has produced about 9,000 tons of raw briquets, of which about 3,000 tons have been recarbonized.

In the Milwaukee installation the coal is powdered and carbonized in suspension in two stages. The pulverized semi-coke is piped to the boiler plant for steam generation after recovery of the distillation products. The rated capacity of the Milwaukee unit is 210 tons per day, and prolonged runs have been made at the rate of nine tons per hour.

The Coal Conference heard fairly complete descriptions of the two German processes for the liquefaction of coal invented by Doctor Fischer and Doctor Bergius. Doctor Fischer first makes water gas from the coal. With the aid of a catalyst this is converted into methanol, or synthetic wood alcohol. This product already has affected seriously the wood-alcohol industry in the United States. With high temperature and pressure and hydrogen Doctor Bergius converts a paste made of crushed coal mixed with a little byproduct oil, into synthetic petroleum. Millions of dollars have been spent on experimental work and it is rumored that two plants will soon be erected in Germany to operate on a commercial scale with a combined capacity of one million barrels of liquid products daily. It should be emphasized that both of these processes differ fundamentally from distillation, as they convert into liquid form not only the volatile matter but most of the fixed carbon as well.

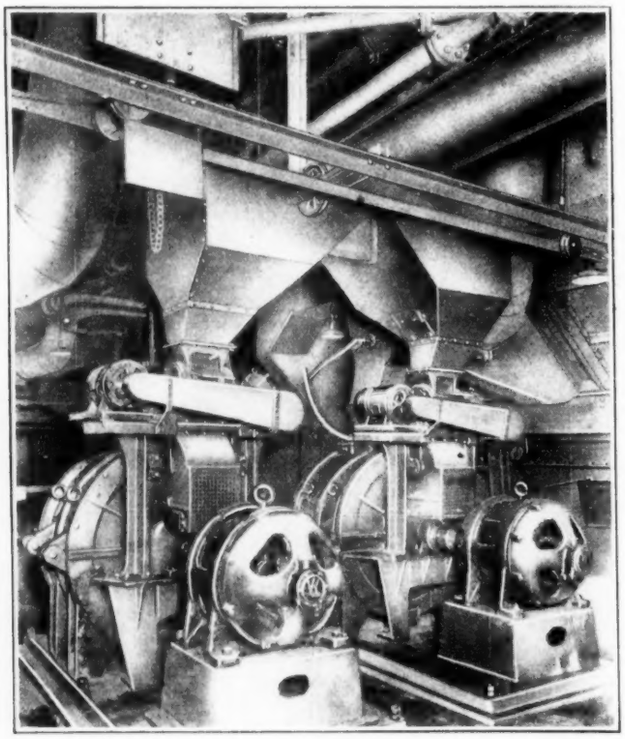
Pulverized-Fuel Equipment

During the last year the number of powdered-coal installations continued to grow, particularly in sections of the country where use is made of inferior coals. Where high-grade Eastern coals are economically available, the growth was not so marked. Owing to the

rapid development of the unit system of firing and the lowering of installation cost on a parity with stoker equipment, the number of installations made in small industrial plants, and in the rebuilding of obsolete boiler plants for the purpose of obtaining higher capacities and efficiencies was noteworthy. Many different types of mill were developed, one company alone having four distinct types of installation; one a high-speed mill making about 1,200 r.p.m., a slow-speed mill of 30 r.p.m. and a unit-central system in which the mills are located on the basement floor and all necessary equipment is within the boiler room. With the arrangement last named the flexibility and efficiency of the central system are combined with the saving in space of the unit system.

Remarkable results were obtained by the revamping of the furnaces and the installation of unit mills at Ashley Street Station, St. Louis, and the trial installation of the unit system for one of the large Cahokia boilers, described in the Nov. 30 issue of *Power*, proved so satisfactory that future boilers are to be so equipped. It will be recalled that boiler efficiencies of 82 to 85 per cent were obtained burning undried coal having 9 per cent moisture and 15 per cent ash in an installation having neither preheater nor economizer.

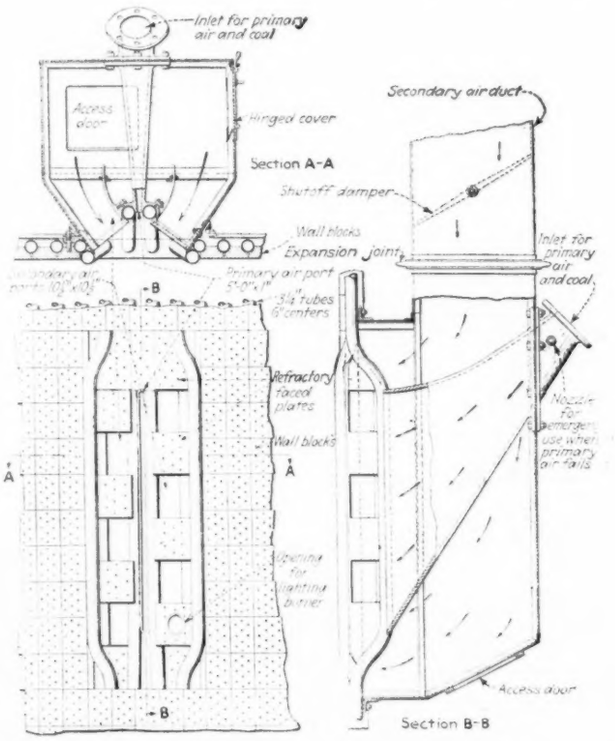
Other major trends in the field are new drying methods and a decided reduction in furnace volumes owing to



Two unit mills at Cahokia Station serving an 18,000-sq.ft. boiler

the use of water-cooled walls, preheating of both primary and secondary air and the introduction of new types of burner designed to effect turbulent mixing of the coal and air. Data from over twenty plants collected by the N.E.L.A. Prime Movers Committee showed a range of furnace volumes for burning powdered coal of between 0.35 and 1 cu.ft. per square foot of boiler-heating surface, with a tendency in the newer installations toward the lower rather than the upper limit. Furnaces constructed with refractory-covered water tubes showed good performance in elimination of smoke at low ratings and capacity for burning large quantities of coal at high ratings. In the plants reporting, heat liberated per cubic foot of furnace volume at maximum ratings ranged from 12,450 to 28,450 B.t.u.

In the same report costs of fuel preparation, including power, steam where used, operation and maintenance, ranged from 15 to 23c. per ton and the total power consumption per ton of coal for mills, conveyors, fans, etc., varied from 15 to 23 kw.-hr. The power requirements of course vary with the coal and the complexity and size of the installation. With a unit mill located close to the boiler, considerable power using equipment is eliminated, so that power figures as low as 8.1 kw.-hr. per ton have been quoted.



Calumet pulverized-coal burner adapted to furnaces with water walls

To reduce the power cost of pulverizing and the tendency of wet coal to pack and clog the system, numerous methods of drying have been tried with varying success. Owing to more effective use of the heat in the flue gases and the increasing use of water-cooled surface in the furnace, driers using heated air from hollow furnace walls or the flue gases are giving way to other types or are drawing their heat from other sources. A late innovation is the use of a part of the preheated air supply. Heating with steam in hollow grids combined with a draft of warm air through the drier to absorb and carry away the moisture has been effective, and better results are anticipated by the use of baffling to force the air to take a longer path through the coal.

Elimination of dust, both coal and ash, is a problem being given increasing attention. Water sprays, bag filters, Cottrell electrical precipitators, Cindervane fans and special forms of collector are being used, but some of these systems are reported to have their limitations,

owing to first cost, bulkiness or low efficiency. At Trenton Channel, improvement in the electrostatic dust eliminator has been demonstrated by the substitution of vertical instead of horizontal wires and concrete plates in preference to corrugated sheet-iron plates.

Wear in transport lines, conveyors and particularly in the blades of mill exhauster fans has been severe. At Detroit, fan blades have been replaced for every 10,000 tons of coal milled. For these blades a variety of materials have been tried, but to date boiler-plate steel has given the best results.

Probably one of the most modern powdered-coal installations made during the year is the test equipment at the Calumet station to which previous reference has been made. Here a boiler of 6,000 sq.ft. of heating surface is designed to deliver twice as much steam as the stoker-fired boilers in the plant containing 15,000 sq.ft. of surface. In the former boiler all the tube surface is exposed to the radiant energy of the fire. The furnace has a volume of 12,000 cu.ft., or 2 cu.ft. per square foot of boiler surface, and a refractory-covered wall area of 2,442 sq.ft., all of which is effective heating surface. Back of the boiler is a water economizer having 8,850 sq.ft. of surface and an air preheater with 41,700 sq.ft. of surface ,which is practically seven times that in the boiler. Air preheated to about 300 deg. F. is provided for primary and secondary use and a certain proportion of this hot air is delivered to the coal drier. The burners are adapted for horizontal firing.

In the uptake from the air heater is a special gas washer to remove the dust from the gases, and another item of interest is the pulverized coal feeder and meter below the bunker. The coal is pulverized in a 15-ton ball mill and is pumped in an air stream to the overhead storage tanks. Full automatic combustion control is provided, and on the control board are instruments showing steam temperatures and pressures and the total quantity generated, water and gas temperatures at various points in the cycle, rate of coal feed and air pressures. In fact, all operating data needed for intelligent operation of the entire installation are made available.

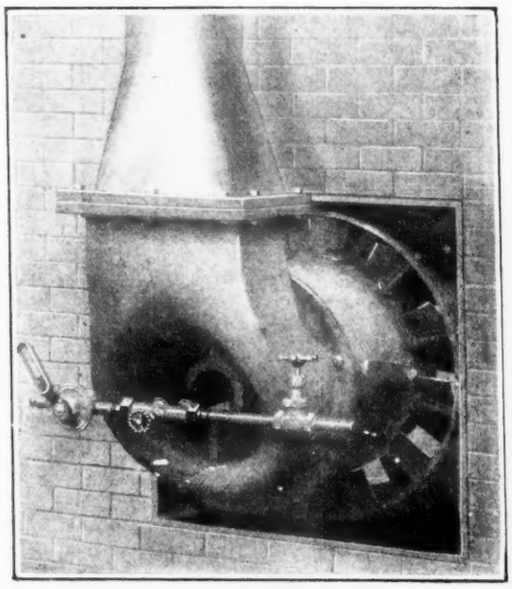
There was considerable activity during the year in the development of combination burners for pulverized coal, gas and oil, the burners being designed to burn any one of the fuels separately or all in combination. Three burners of this type are now available. Other burners of comparatively recent development are the horizontal turbulent type now being used at the Ashley Street Station at St. Louis, and the Calumet burners, first used at the Calumet Station at Chicago. The last-named is essentially a horizontal, short-flame type, designed especially for adaptation to certain types of water-cooled furnace wall construction. In this burner the primary air and pulverized coal enter the furnace horizontally through a narrow vertical slot approximately 1 in. wide by 5 ft. in height, while the secondary air enters through ports on either side of the primary jet.

Among the several improvements and refinements made in the line of unit pulverizers was the development of a ball mill with classifier, capable of handling small quantities of coal, even as low as 100 lb. per hour.

Mechanical Stokers

In the course of the year two new types of chain-grate stoker have been brought out, one for the burning of anthracite and coke breeze and the other for bituminous and lignite fuels. One or two new hand stokers have been developed, and improvements have been introduced in existing types. A number of new types of suspended arches using small tile have been developed and also new side-wall construction.

In the field of underfeed stokers the tendency has been continually toward larger units and higher capacities. Stokers may be had that will give 450 per cent of boiler rating continuously and 700 per cent on peaks



Combination burner for pulverized coal, gas and oil

with the modern boiler. Briefly summarized, the outstanding developments of the year include:

Increasing trend toward long stokers, 41 tuyeres and up, for firing large boilers.

Continued development of the stoker for use with preheated air, has made possible material reduction in furnace volumes and better performance. This includes increased area through the tuyeres and improved grate block construction.

New high marks in stoker efficiency and boiler output are being revealed by operating data in the new modern stations, such as Hell Gate, Kearny, Edgar and Richmond, which are now on an operating basis.

Adoption of underfeed stokers for firing the largest boilers in the world at the Beacon Street central heating plant in Detroit.

New principles of design to reduce maintenance costs on stoker parts.

Improvement of efficiencies at high ratings is one thing, but boilers also operate at low ratings. To take care of this problem, separately controlled air zones for the forced-draft air supply have been introduced under the stoker, so that by means of air control high efficiencies may be maintained over a wide range of load.

A plan for giving improved air distribution with reduced air pressure is the use of a secondary ram consisting of a short tuyere stack which forms the retort bottom and has a stroke adjustable from 3 to 6½ in. Clinker rolls are being made much larger than formerly, especially for large stokers and high-ash coals. To chill the clinker and make it brittle before coming in contact with the rolls, certain installations are using water

sprays, with the discharge limited to give just the desired cooling effect.

An arrangement that is being watched with interest is an automatic air control built by the American Engineering Company for the boilers at the Edgar Station. In this the fuel bed area is divided into sections by metal boxes suspended below the stokers, and the air supply to each box is controlled by an ingenious form of constant volume regulator employing a form of venturi nozzle.

It may be of interest to point out that at the Providence meeting of the American Society of Mechanical Engineers last May, H. W. Leitch, of the United Electric Light & Power Company, presented curves of test results with later stoker installations at Hell Gate Station, which showed furnace efficiencies, based on saturated steam temperatures, ranging above 96 per cent for various rates of heat liberation up to 30,000 B.t.u. per hour per cubic foot of furnace volume. Over-all efficiencies, including furnace, boiler, superheater and economizer, exceeded 92 per cent and did not drop below 80 per cent until the boiler was forced above 400 per cent of rating.

Overfire air injection, and preferably heated air, for bettering combustion conditions has been more or less common with chain grates. The air is introduced at the front of the furnace, where there is usually a deficiency of oxygen, at sufficient velocity to mix the products of combustion thoroughly, with the result that smoke is reduced and efficiency improved. This same plan has been tried out with good results on underfeed stoker installations having small furnace volume.

Stoker sales, as reported to the Department of Commerce, show a gain in business over the previous year notwithstanding the encroachment of powdered-coal equipment. Some very large stokers have been installed, and there has been a marked increase in the use of automatic stokers on the smaller sizes of boilers, some boilers having not more than 1,000 sq.ft. of surface.

Progress in Steam Turbines

GREAT increase in size of units; live steam reheaters introduced; small turbines improved; wide use of bleeding and high-back-pressure turbines efficiently to combine power heating and process; condensers of improved design and less surface.

DEVELOPMENT of the steam turbine during 1926 has been marked by the building of more and more units of large capacity, by the increased use of the regenerative heating of feed water by steam extracted from the main turbine unit, by a continued use of steam reheating in some cases, by a number of refinements of design details, and by the extension of the improvements developed for large turbines to units of smaller capacity.

Fifteen years ago the starting of a 20,000-kw. Curtis turbine at the Waterside Station in New York was made the occasion of a fitting ceremony, during which many marveled at the tremendous capacity concentrated in a single machine. Not long after, units of 30,000-kw. capacity had been developed, then 45,000-kw. in a single cylinder, and as stations grew larger in size, the 60,000-kw. compound machine was heralded as the ultimate limit in unit capacities. No one could foresee, of course, the tremendous growth that was to take place in central-station service, the building up of great networks for distribution, the interconnection of these extensive systems and the establishment of base-load plants to serve in common and wholesale the energy in large blocks as dictated by load conditions.

Owing to this enormous expansion it is not surprising that attention was soon given to units of greater capacity. A 77,000-kw. compound unit was installed at the Crawford Avenue Station in Chicago, followed by an 80,000-kw. turbine for the Hudson Avenue Station in Brooklyn.

In single-cylinder machines there is one building of 50,000-kw. capacity for the Waukegan plant and a 63,000-kw. unit for the Edgar Station in Boston. The latter will establish a record for capacity at any speed in single-cylinder units. A compound unit of 160,000-kw. capacity has been ordered for the Hell Gate Station in New York City. Within a single week during the early fall, three orders were placed for steam turbine units of great size. Two of the machines will be 90,000-kw. units for installation on the Pacific Coast, one a 104,000-kw. for Chicago, and the third a 208,000-kw. turbine-generator to be installed as the first unit in the new State Line Station at the southern end of Lake Michigan.

These developments have been shared by the General Electric Company, the Westinghouse Electric & Manufacturing Company, the Allis-Chalmers Manufacturing Company, and the American Brown Boveri Company.

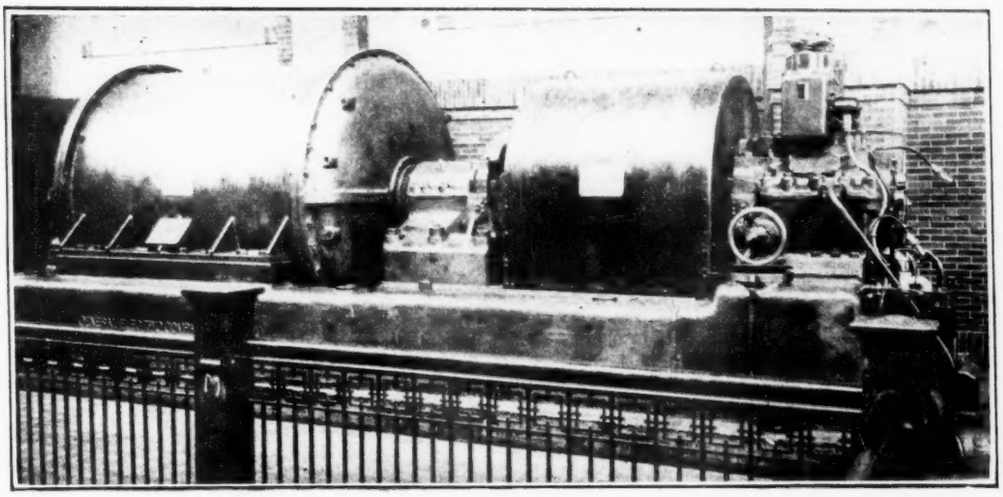
The 160,000-kw. unit for Hell Gate is to be a cross-compound machine, with a 75,000-kw. high-pressure unit running at 1,800 r.p.m., and an 85,000-kw. low-pressure unit running at 1,200 r.p.m. The generators are designed for 0.85 power factor and will generate at 13,200 to 14,500 volts. Steam will be supplied at 265 lb. per sq.in. gage with 200 deg. F. superheat and will be extracted at two stages to heat the feed water. The unit will weigh 1,400 tons, and will occupy a floor space of 25½ by 69 feet.

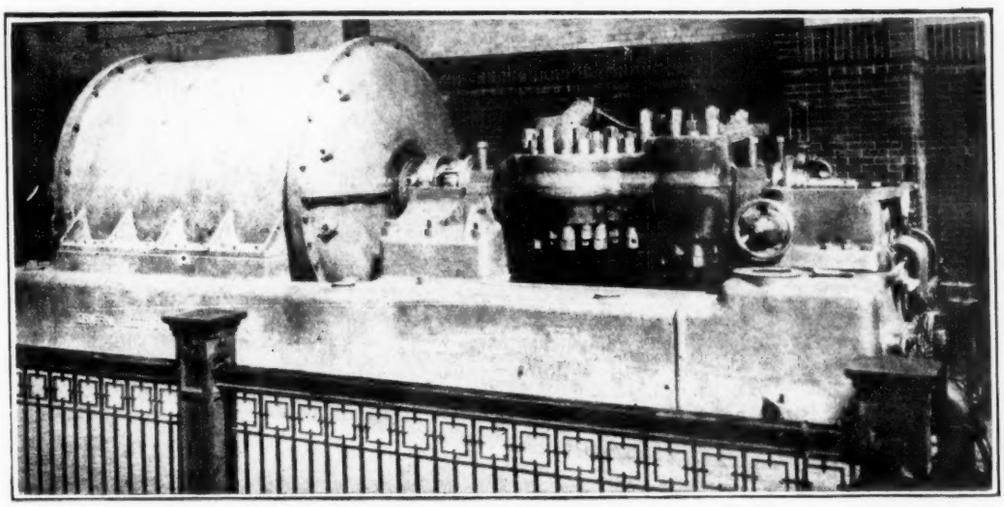
Some Details of Largest Unit

To visualize what this enormous capacity means, the energy production of the 208,000-kw. unit will be sufficient to care for the electrical needs of a good-sized city. Its complete weight will be approximately 4,000,000 lb. Each hour more than 120 tons of low-grade Illinois coal will be consumed for steam generation, 24 million gallons of condenser cooling water will be pumped and the generator cooling air will total 21 million cubic feet.

As may be recalled, the machine has a high-pressure element of 76,000-kw. capacity and two low-pressure elements of 66,000 kw. each. Steam supplied to the high-pressure turbine at 600 lb. gage and 730 deg. F., will be exhausted to a reheater using live steam, where

Two High-Pressure Turbines



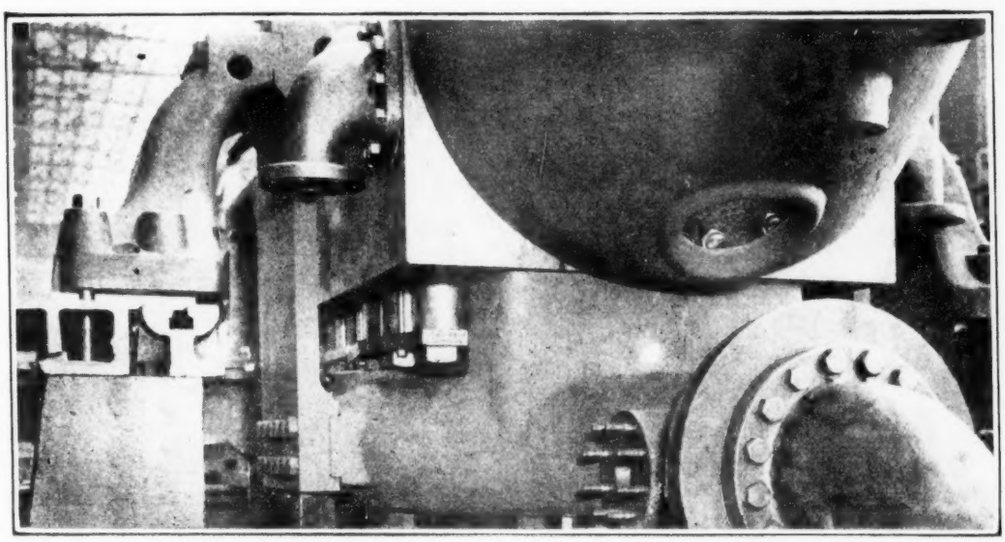


The 1,200-lb. General Electric unit in the Lakeside plant of the Milwaukee Electric Railway & Light Co. was officially started on Nov. 6, 1926

See POWER for Nov. 30, 1926, page 822.

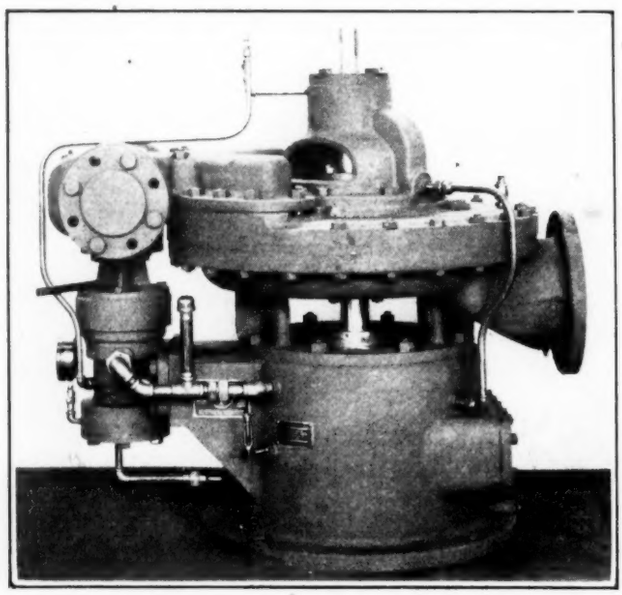
This view (below) of the lower half of a Westinghouse 800-lb. turbine shows the heavy steel forging that forms the casing and the ingenious methods of support

The casing rests on the exhaust chamber, which is hung from supporting stools at the level of the shaft center line. The supports are hollow and will be supplied with steam at about the same temperature as that within the cylinder, so that alignment will not be affected by temperature.



it will be raised to a temperature of 500 deg. and passed in equal quantities to the two low-pressure turbines. The machine will incorporate the largest 1,800-r.p.m. generator ever built, and it will be the first to generate current at 18,000 volts.

In view of the foregoing, predictions on unit capacity are out of the question; as expressed by a prominent authority in the field, the various compounding arrangements will permit the construction of turbines of almost any size, the only limitation being the area of the exhaust annulus and the restrictions imposed in transportation. Operating pressures for these large machines range from 400 to 600 lb. per sq.in. with steam temperatures as high as 750 deg. F. It seems safe to say that for large stations these steam conditions are now generally accepted as representing conservative engineering practice. For units of 50,000-kw. capacity some manufacturers continue to build single-cylinder machines, while others prefer the double-barrel construction, with the two turbine sections either in tandem or cross-compound. For capacities much over 50,000-kw. the compound construction with either two or three elements is widely used.



A vertical turbine with oil relay governor and self-contained lubricating system

In units of this sort it seems to be increasingly common to extract steam from four stages of the turbine for heating the feed water to a temperature approaching the boiling point for the initial steam pressure. There appear to be no unforeseen difficulties in operation on the regenerative cycle, and, for large stations at least, it may be considered a well-established practice.

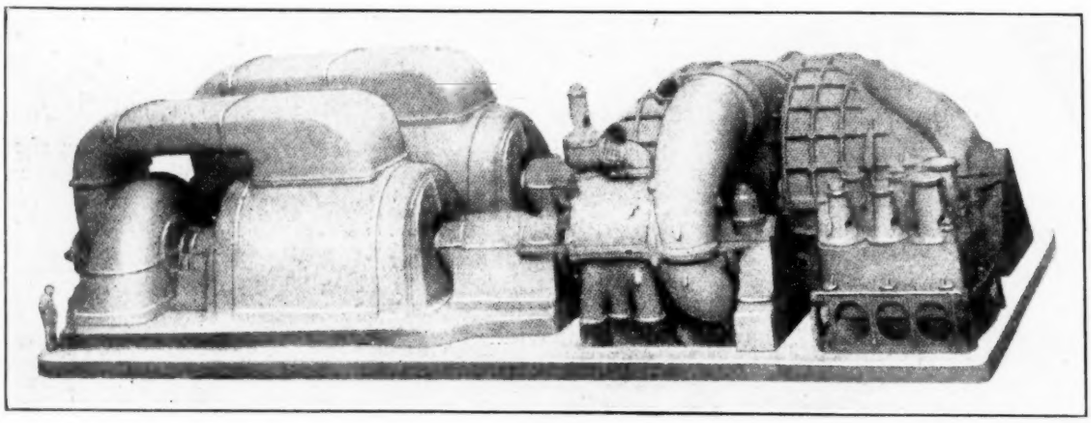
Higher Turbine Speeds

As higher turbine speeds lead to lower cost of the unit, since fewer stages are needed for the same efficiency and since the generator is smaller, the trend for large turbines has been toward higher speed. It would appear that turbine design is approaching the point where 1,800 r.p.m. will be regarded as the usual speed for large turbines. A number of the very large machines on order are to operate at this speed. Improved materials are being used to withstand the greater stresses in turbine rotors and buckets, and more effective ventilating systems to overcome the limitations that have been imposed by the generator.

An interesting feature in this realm is the continued use of high turbine speeds by one of the leading manufacturers whose units usually drive through reduction gears, so that the turbine speed may be chosen to give the best operation for the turbine. For units of 450 hp. they run the turbine at 10,000 r.p.m., and for 2,200 hp., at 5,250 r.p.m., with intermediate steps of 6,000 and 7,000 r.p.m. These units have been designed for high steam pressure and temperature and necessarily involve many refinements of design to meet the severe conditions. Above 1,500 hp. the same firm has developed a line of compound geared turbines admirably suited to economical and reliable operation. The speed is selected for the high- and low-pressure elements independently, so that optimum conditions are secured for each portion of the pressure range.

Reheating by High-Pressure Live Steam

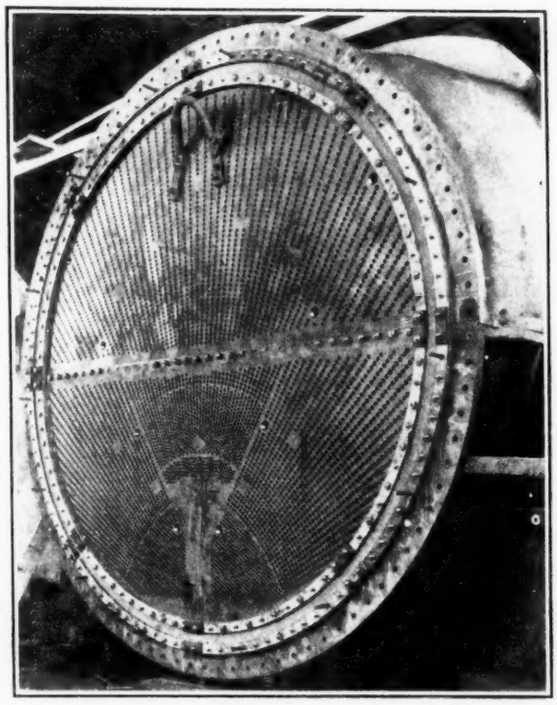
If dry steam is desired throughout the range of expansion in the turbine, it is necessary to resort to reheating for increasing the temperature of the steam after it has passed through a part of the turbine. Four stations in this country and one in England have demonstrated the practicability and economy of reheating accomplished in special secondary superheaters installed in the boiler setting and receiving their heat from the combustion gases. An objection to this method is that the steam has to be carried from the turbine to the boiler room and back to the turbine, involving considerable complication and rather large pipe lines, owing to



This is a model, constructed by Brown Boveri Co., of the 160,000-kw. cross-compound turbine for the Hell Gate Station of the United Electric Light and Power Co., of New York City

the comparatively low pressure of the steam to be reheated.

In order that the advantages may not be offset by expense and complication, it was recognized several years ago that it would be desirable to find means to reheat the steam at or near the turbine. The passing



In this condenser, with one tube sheet floated on a rubber diaphragm, tubes can be expanded in at both ends

year has brought out a design by which this is accomplished in a reheater using high-pressure live steam. For this type of reheater, described in detail in *Power*, May 18, 1926, two orders already have been placed for use in connection with two large machines given previous mention. It has been pointed out that one of the advantages of this reheater will be the use of a comparatively small amount of live steam, owing to the fact that as its pressure is much higher than that of the steam to be reheated, use may be made of the latent heat.

Turbines for 1,200 Lb.

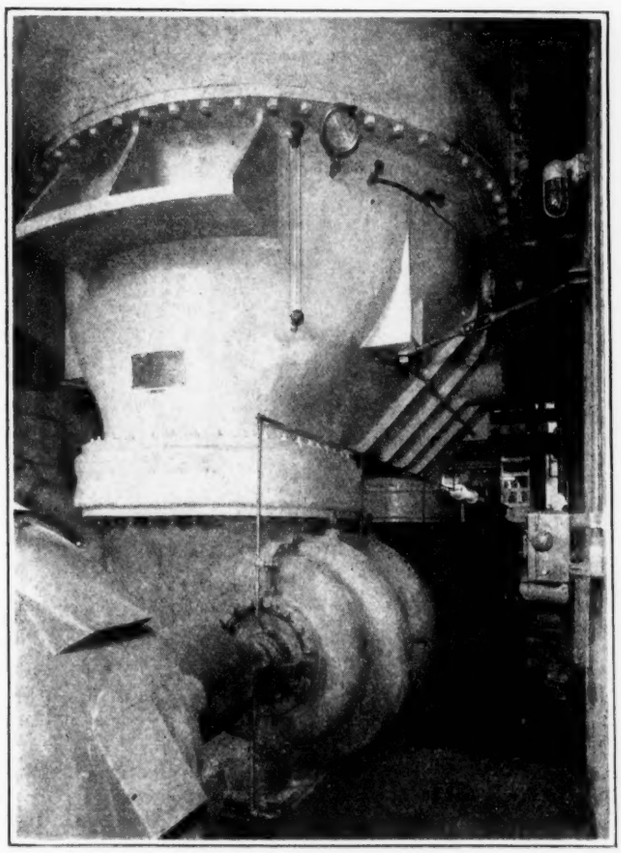
There are now operating in this country two units receiving steam at a pressure of 1,200 lb. per sq.in. The 3,000-kw. unit in the Edgar Station of the Boston Edison Company has proved its reliability by long-continued operation, and on careful inspection it seems to show no signs of trouble peculiar to high steam pressure. Late in the year a similar unit of 7,000-kw. capacity went into regular service in the Lakeside Station of the Milwaukee Electric Railway & Light Company, and there is no reason for expecting anything but a record of continuous satisfactory performance.

There has been no attempt to use steam at temperatures higher than 750 deg. F., owing to the lack of confidence in materials available, but the manufacturers of valves and fittings express their willingness to provide equipment for more severe service.

There has been much attention to the details of design and construction such as governors, oil pumps, thrust bearings and the like. Steel castings are, of course, still used for the high-pressure casings of large machines, and refinements of design make it easier to secure good castings. For the 12,000-lb. turbines mentioned previously, the casings are steel forgings of exceptional weight and stiffness, to avoid trouble due to misalignment. The soundness of both castings and forgings is the subject of close inspection by all manufacturers.

High-Back-Pressure and Bleeder Turbines

For the industrial plant requiring steam for process heating, extraction and high-back-pressure turbines continue to be built in increasing numbers, and for higher initial steam pressures and temperatures. For instance, there are several units now in operation receiving steam at around 400 lb. gage, exhausting to process at 50 to 100 lb., and at the same time delivering steam through extraction nozzles at a constant pressure of 125 to 150 lb. to run engines and other equipment formerly supplied with live steam. The industrial plant engineer is coming to realize more clearly the manifold possibilities for combining power and heat demands



***The largest jet condenser in the world is operating** in the Eddy St. plant of the Narragansett Electric Lighting Company*

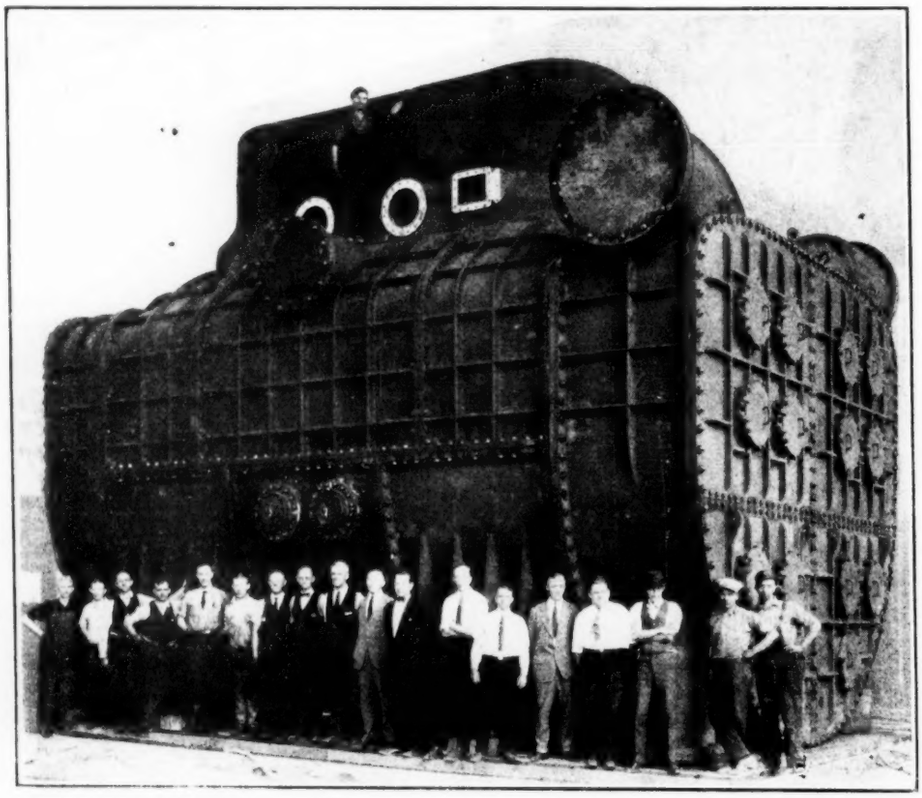
through the use of turbines which can so readily be adapted to serve several purposes.

Turbines have been built and are now available for extraction of steam at two pressures, both automatically maintained constant, with close speed regulation. The higher steam pressures in use today make possible a big return from the use of turbines as power-producing reducing valves.

For auxiliary drive in large plants, builders of small

turbines have developed machines built for initial steam pressures of 400 lb. per. sq.in. with temperatures up to 750 deg. F. Steel casings, with stainless steel buckets, valve parts, etc., are features of such units. Not only do they provide small turbines suitable for the large plant, but they make it easier for the small industrial plant to follow the central station in the adoption of higher pressures and temperatures, and thereby to share the gains in economy accompanying such operation. The way is also open for building such machines for the extraction of large quantities of steam at pressures as high as 150 lb. gage.

High-pressure turbines exhausting into the steam header of a low-pressure plant will materially increase the power capacity with a comparatively small increase in the steam used. Where power demand has grown faster than the demand for exhaust or extracted steam, a machine of this type affords possibilities of large savings.



One of two 54,000 sq.ft. surface condensers for the Dukeville, N. C., plant of the Southern Power Company, each serving a 37,500-kw. turbine with high water temperatures during the summer months

During the latter part of the year the Standard Turbine Corporation has brought to public notice a new design of turbine for auxiliary service in the large plant or for main service in the industrial establishment. This turbine has needle-valve steam nozzles so that it can readily be adjusted to operate with good economy under a wide range of loads and steam conditions. It is hoped that further details will appear in *Power* at an early date.

Condenser Developments

A valuable contribution to the knowledge of condenser performance was made in three papers presented before the annual meeting of the A.S.M.E. giving data on the operation of thirteen condensers in actual service for periods ranging from a few months to more than fifteen years. Increasing light on what happens within the condenser will serve to lay a firm foundation for intelligent improvement of its design.

Smaller Surface Effective

In the condenser field the progressive manufacturer boasts, not of the large size of his product, but of its smallness, capacity considered. Owing in part to the large quantities of steam bled for feed water heating, with less going to the condenser, it is not uncommon to find less than one square foot of surface per kilowatt. There seems to be definite progress toward the increased effectiveness of condensing surface through the intelligent arrangement of tubes and proper direction of the steam flow. In general, the effort is to reduce the loss in pressure incident to forcing the steam to penetrate a closely spaced tube bundle.

An interesting development by one manufacturer for longitudinal distribution of the steam is the division of the condenser into sections by making the tube-supporting plates tight and connecting graduated vapor and air nozzles between these sections. By maintaining an appropriate pressure drop in each section, complete penetration of the tube bundle is effected.

There has been noticed a tendency to make use of the ability of a properly designed condenser and air pump to produce absolute pressures as low as 0.5 in. of mercury with cold circulating water. Improvements in turbine design have made it possible to use such low exhaust pressures effectively.

Applications of the vertical type of condenser continue and the single-pass condenser has been gaining in favor. One manufacturer has developed a floating tube sheet condenser design which permits expanding the tubes at both ends, and is said to eliminate leakage of raw water into the steam space. He has also designed a condenser arrangement that permits the direction of water flow to be reversed readily, without piping external to the condenser, with a view of keeping the tube interiors free from accumulations of silt and vegetable matter. A three-stage air ejector has been perfected that should result in a further reduction in the amount of steam used for air removal.

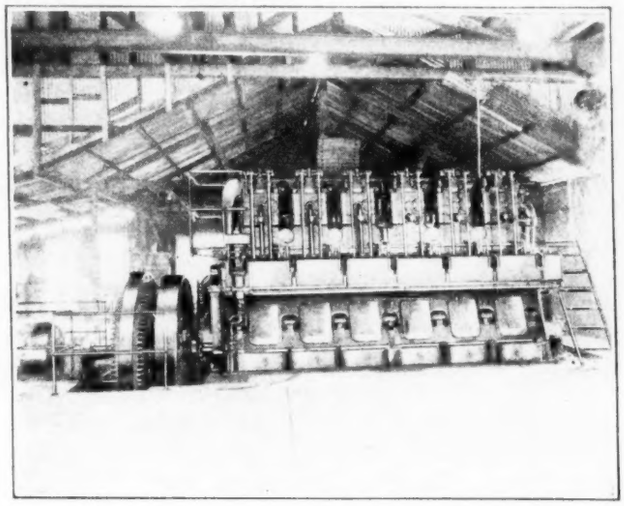
The factors governing the performance of a condenser are gradually coming to be better understood, and experimental investigations now on foot here and there are slowly supplying the specific numerical data needed by the designer. All this technical advancement is reflected in the design of equipment, and condensers and their auxiliary pumps, while showing little change in external appearance, are developing faster than ever before.

Oil Engines in Many Fields

OIL ENGINES go into many fields. Large Diesels have become commercial actualities. High-speed engines were developed during the year for contractors' machinery. Central stations continue to purchase Diesels for isolated stations. Export business shows an increase due to developments in South American oil fields. Several railroads have purchased oil-engine locomotives for both branch and main line services. The sales for 1927 will probably be ahead of the 1926 record.

THE year 1926 is noteworthy in oil-engine development as witnessing the actual construction of designs developed on the drawing boards during previous years. This includes, in this country, such contracts as 3,000-hp. 90-r.p.m. double-acting engines for the Shipping Board, 3,750-hp. units for the Panama Canal, V-type engines for locomotive use and high-speed Diesels for power shovels, compressor drive and like work.

While marine activities interest but a minor percentage of *Power's* readers, all are concerned with the attempt of the Shipping Board to instill life into the American Merchant Marine. The decision to recondition a number of vessels by discarding the steam equipment and installing Diesel engines was met with general acclaim. It is to the Board's credit that practically all builders who offered bids on the engines were awarded contracts. As a result there will be a valuable opportunity to study the relative performances of the single- and double-acting engines operating on both the two- and the four-stroke cycle. At present engines have been delivered by the Worthington Pump & Machinery Corp., the McIntosh & Seymour Corp. and the Busch-Sulzer Bros. Diesel Engine Co. Other builders are expected to be ready soon to run acceptance tests.

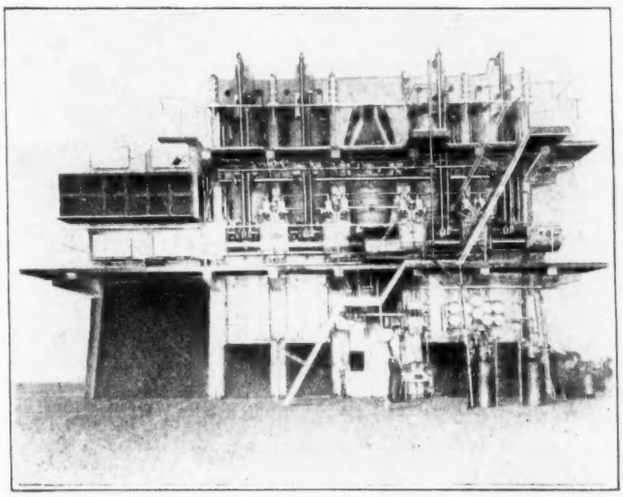


Solid-injection 1,000-hp. Diesel installed at Lake Worth, Fla.

From a strictly power-engineering point of view the chief value in these Shipping Board contracts is that builders have been enabled to proceed with the construction of large units and are now in position to supply similar capacity units for industrial and other process purposes. Such engines of 3,000 to 4,000 horsepower are large enough to meet practically all requirements, by the use of single or multiple installations.

Mention has been made of the three 3,750-hp. units purchased in 1925 by the Panama Canal Commission. These Nordberg two-stroke-cycle units were built and shipped during 1926. Another outstanding Diesel power plant designed during the year is that of the Commerce Royalty & Mining Co., Miami, Okla. Contracts have been placed for four 2,000-hp. Nordberg Diesels, which, when installed, will supply power to the company's several mines and mills in the Pritcher, Okla., lead fields.

Other installations made during the year include many in Florida ranging from 2,000 hp. downward, also a 1,160-hp. two-stroke-cycle engine added to the three smaller units in the Freeport, Long Island, municipal plant, the largest Diesel central station in the North Atlantic States.



A 3,000-hp. Hooven, Owens, Rentschler double-acting Diesel

As *Power* has predicted in previous years, the field for engines of under 500 hp. is being rapidly occupied by solid-injection units to the exclusion of air-injection types. These have been fairly evenly divided between four- and two-stroke-cycle units.

For oil-pipe lines four-stroke-cycle solid-injection engines are being preferred in sizes under 500 hp., and the De La Vergne Machine Co. has shipped approximately twenty of these to the South American oil fields.

The crankcase compression two-stroke-cycle engine has had an enormous sale in capacities under 300 hp. During the year Fairbanks, Morse & Co. started to build on a production basis an engine of 600 and 720 hp.

rating. Unlike the smaller units, this engine does not employ crankcase compression, but has instead a scavenging air pump.

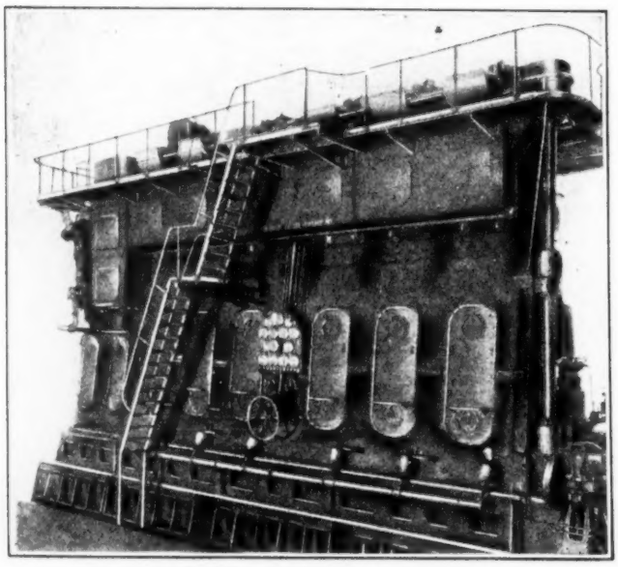
Locomotive requirements have prompted the construction of engines of unusual design. One company has produced a V-type Diesel for locomotive use on the New York Central Railroad, while it is reported that another company is designing an 800-hp. V-engine for the Pennsylvania Railroad. At present there are about 20 Diesel locomotives in use or in process of construction.

Two American Firms to Build Foreign Engines

The adaptation of the Diesel to such service as power shovels and industrial locomotives has held the attention of many designers. In Germany the Benz Co. and the M.A.N. Co. have produced units of the light-weight, high-speed type, and both of these concerns have sold licenses to American firms during the last year. The Benz will be built by the Chicago Pneumatic Tool Co. and the M.A.N. by the Buda Co.

A purely American design is embodied in the Foos high-speed Diesel, developed during the year. This runs at speeds up to 900 r.p.m., being rated at 25 to 40 hp. per cylinder and weighs 40 lb. per horsepower. Direct pump injection is used without a precombustion chamber.

Several other builders are developing light-weight engines, as the field for such units is very broad.

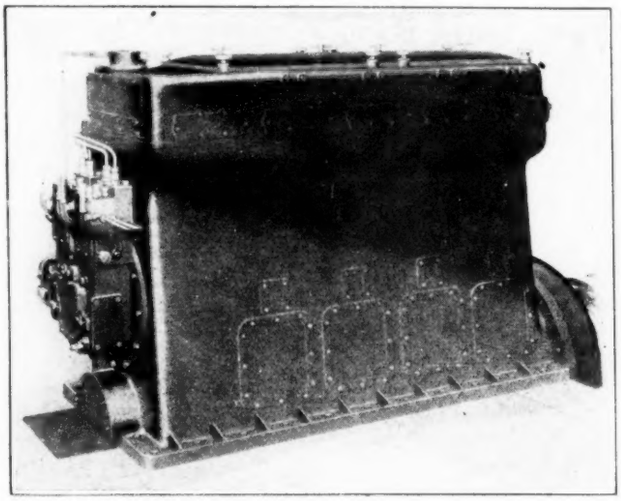


A six-cylinder 3,000-hp. two-stroke-cycle single-acting engine

Among these are Fairbanks Morse & Co., who have brought out an engine operating at 800 r.p.m. and rated at 10 hp. per cylinder. The engine frame is a one-piece casting and is carried up to accommodate the cylinder bores. Owing to the small cylinder dimensions no liners are used.

An interesting sale was made during the year of 40 high-speed engines direct connected to gas compressors to increase the flow of Oklahoma oil wells. These engines were after the Benz Diesel designs, but the builder, the Chicago Pneumatic Tool Co., arranged new heads and other details to permit the units to be operated on natural gas until such time as oil fuel is used.

The Humphrey internal-combustion pump failed to meet with the success anticipated for it when first introduced several years ago. Some time ago the plan of using the inertia of a body of water as the agency for obtaining power from the explosion charge was replaced by a design of pump in which a heavy piston reciprocated in a cylinder and by its inertia carried on the operations previously performed by the body of water in the Humphrey pump. One such pump was built and during the year has been the subject of many tests. It



A 400-hp. high-speed Diesel

is expected that when oil is used as the fuel, a wide field of application will be found for the unit in irrigation, drainage and water-works plants as well as in oil-well pumping service.

From a commercial point of view 1926 was not as excellent a year as 1925. The total horsepower sold, this being different from horsepower shipped, was 20 per cent under the sales for 1925. Some attribute this to a public scare over the report of the Federal oil committee, but the greater influence was the fact that there existed a general decrease in new plant contracts, including central stations, industrial plants, etc., due to a more or less saturated condition.

Power has completed a very exhaustive survey of the Diesel engine industry, which will appear in the Jan. 10 issue. It was found that there are 1,175,765 hp. of Diesel or cold-starting engines in use. Of these 815,000 hp. have been built since 1921, and based on the installed horsepower in 1913, the present total represents an increase of 2,600 per cent. In view of the fact that the central-station industry is rapidly discontinuing the small station, it is somewhat surprising to find that since 1921 over 130,000 hp. of Diesels have been placed in central-station service.

The oil pipe lines have definitely abandoned the use of any power for their pumping plants other than oil engines. Today there are approximately 250,000 hp. in such plants, of which 170,000 hp. are in the Mid-continental field.

As has been pointed out, the solid-injection crankcase compression engine has almost monopolized the under 500-hp. class, and the solid-injection types are coming into general use in larger sizes.

The outlook for 1927 is somewhat more favorable, in both stationary and marine power fields

Water-Power Development Active

DURING the first part of the year business was somewhat dull, but in the latter half it became unusually active. In new projects contracts were let for over 1,500,000 hp. in this country and Canada. Many large projects are under way that promise a healthy condition in the industry for the next year.

WATER-POWER development seems to have a way all its own of keeping in the progress procession. Notwithstanding all the difficulties placed in the way of its utilization, each year records healthy advances. At the time of writing the review for 1925, one year ago, the prospects for 1926 did not look promising. A number of large projects that had been under construction for two or three years were completed or nearing completion, and there did not appear to be any large business in sight to take their place. The Conowingo development, which had looked promising at the beginning of 1925, became badly involved in a number of controversies that threatened to tie it up indefinitely, but during the first half of the year these difficulties were cleared away and a license was issued by the Federal Water-Power Commission to go ahead with the project.

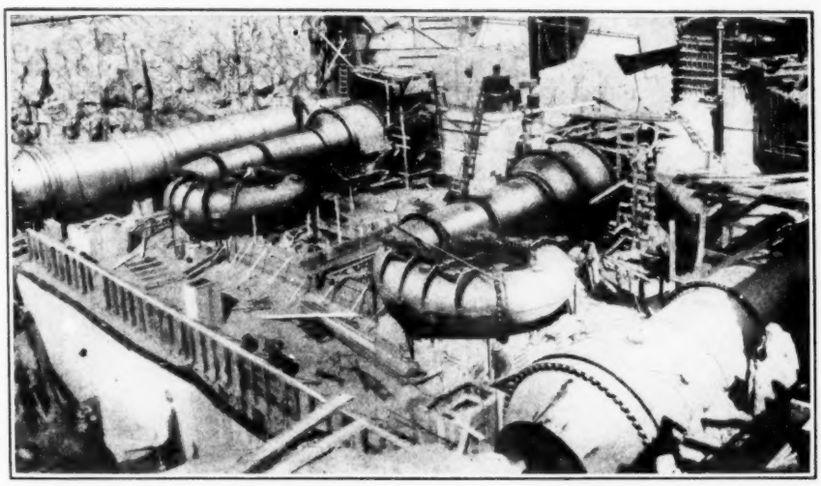
The first six months of the year about bore out the dull prospects that appeared to be ahead for the water-wheel industry, but the last half more than made up for the first and the year closed with contracts let in this country and Canada for over 1,500,000 hp., about 500,000 hp. of which was in Canada. These orders were accompanied by others for a large volume of equipment in the form of valves, gates, roller-type dams, etc. Although most of these contracts came too late to make a good showing on the cash side of the ledger, they have given the shops work that was badly needed.

Unfortunately for the advancement of the art, the prices for the 1926 hydraulic equipment were rather depressed, the production capacity in the early part of the year exceeding the market requirements. Depressed prices retard the development of the art on account of the small margin of profit not providing the funds necessary to carry on experimental work essential in new developments. This is not a healthy condition, since there is a large field for development in hydraulic-turbine designs.

Low prices for fuel and a temporary overdevelopment of water power on the Pacific Coast resulted in unprecedented activities in steam-power development in that section of the country during 1926. Notwithstanding this, contracts were placed for well over one-quarter million horsepower of hydraulic turbines to be installed west of the Rocky Mountains.

The present fairly healthy condition of water-power development is borne out by the sixth annual report of the Federal Water Power Commission for its last fiscal year, during which construction was started on 20 projects which will have, when completed, an installation of 1,220,000 hp., or 40 per cent of the total placed under construction during the preceding five years. Among these new projects are: Lock No. 18, development of the Alabama Power Co. of 180,000 hp. on the Coosa River; the 135,000-hp. combined power and navigation development at the Falls of the Ohio, Louisville, Ky.; the Conowingo development on the Susquehanna River in Maryland and Pennsylvania; and five projects in California, aggregating 417,000 hp. These projects bring the total of plants placed in operation or under construction under license of the commission since July, 1920, to nearly four million horsepower.

One of the outstanding major projects in this country and Canada is the St. Lawrence. Although at present its development seems to be almost hopelessly tied up in politics, the Joint Board of Engineers of the United States and Canada, appointed in 1924 to examine and report on the project, made its report this year, which was favorable to carrying out the development. Although more comprehensive than the one issued by the Joint Board which reported on the project in 1922, this report agreed in the major details with the 1922 recommendations. Although how, when and by whom the development shall be made is something for the future to decide, the general engineering features and their practicability seem to be fairly well settled. The two applications made to the Water Power Commission of New York State for a license to develop the international section of the river were with-



Installation of two 24,500-hp. turbines in the Exchequer power house of the Merced Irrigation District

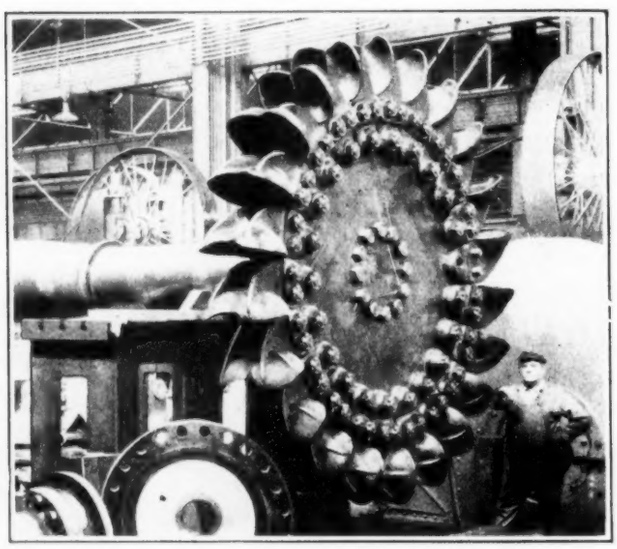
At either side of the two turbines can be seen the two Johnson discharge valves for controlling the water level at the power house

drawn near the close of the year owing to the objections of Governor Smith. The question now to be settled is, Will New York State go into the water-power business or will a private corporation be allowed to do the developing?

The installation of eight units in Muscle Shoals plant, totaling 260,000 hp., was completed during the year and is being operated by the United States Government engineers. Reports indicate that this plant generated about 450,000,000 kw.-hr. in 1926. By 1929 it is expected that the output will be increased to 1,000,000,000 kw.-hr. As to the final disposition of the plant this is still before Congress, and there is little to indicate what the results of the deliberations will bring forth.

The outstanding project from point of size on which work was started during the year, was the Conowingo development. This plant will have an initial installed capacity of 378,000 hp. and an ultimate capacity of 600,000 hp. Contracts have been let for seven complete units having a rating of 54,000 hp. each, to four manufacturers, two waterwheel and two electrical. The turbines are of the vertical Francis type to operate under a head of 89 ft. at 81 r.p.m. These units hold the record as to physical size and are the largest capacity machines built for heads less than 100 ft. The runners have an outside diameter of 17 ft. 9 in. and a total weight of 200,000 lb. and the spiral casings an inlet diameter of 27 ft. Butterfly valves will be placed at the lower ends of the penstocks. These will also be 27 ft. in diameter and will exceed by 6 ft. 6 in. the previous record valves of this type, which were installed in the upper ends of the penstocks of the 70,000-hp. units at Niagara Falls.

At the Bellows Falls plant of the New England Power

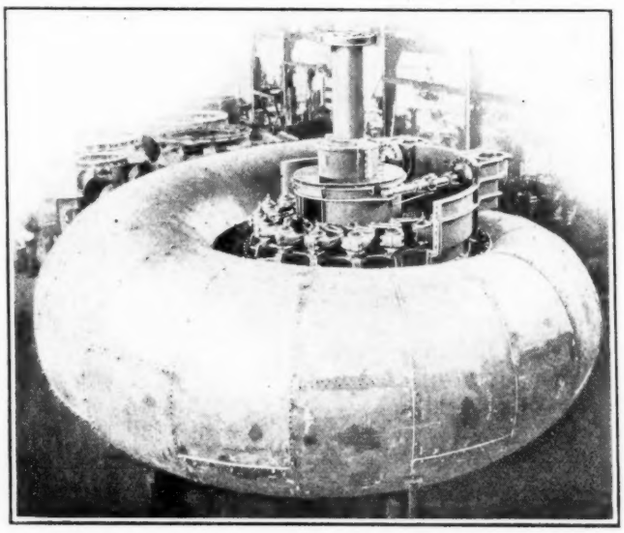


One of the wheels for the 40,000-hp. double overhung unit being installed in the Balch plant to operate under a head of 2,381 feet

Co. three 17,500-hp. units are being installed to operate under a 57-ft. head at 85.7 r.p.m. The units are of the vertical-shaft Francis design with concrete scroll cases. On account of the low head and slow speed the machines are of large dimensions, the runners being about 11 ft. in diameter and weighing 100,000 lb. The company reporting this contract also reports orders for six similar units for two other installations.

In the high-head Francis installation two 33,000-hp. units to operate under a head of 660 ft. at 450 r.p.m. in the Santeetlah development of the Tallahassee Power Co., stands out in the year's business.

For high-head plants using impulse-type wheels, contracts have been let for some notable units. The two 56,000-hp. double overhung units being installed by the Southern California Edison Co. in its Big Creek No. 2-A plant, to operate under a head of 2,300 ft. at 250 r.p.m., are larger by 16,000 hp. than any machine of



One of the two 28,500-hp. turbines in the Bartletts Ferry plant

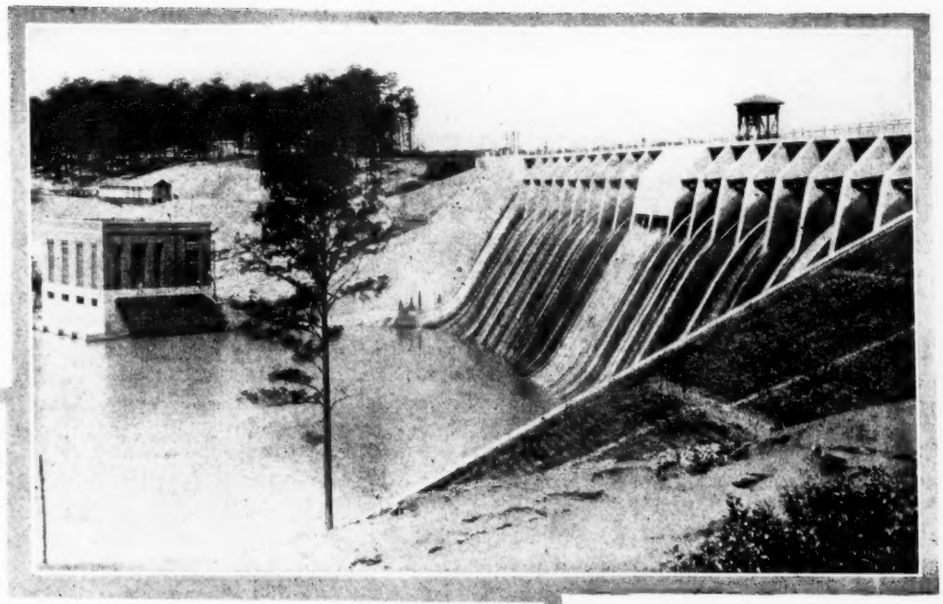
the type previously constructed. The contract for these machines went to two different companies. Another outstanding project is the two 30,000-hp. impulse double overhung units being installed by the Feather River Power Co. in its Bucks Creek development to operate under a head of 2,548 ft. Another high-head unit is the 40,000-hp. machine for the Balch development of the San Joaquin Light & Power Corp., which is to operate under a head of nearly 2,400 ft. In the last two years there has been put into operation or contracts placed for, nearly 350,000 hp. of units ranging in size from 30,000 to 56,000 hp. and for heads of 1,900 ft. and above. Two of these units, rated at 40,000 hp. under 2,450 ft. effective head, were built for the Sao Paulo Tramway, Light & Power Co. in Brazil.

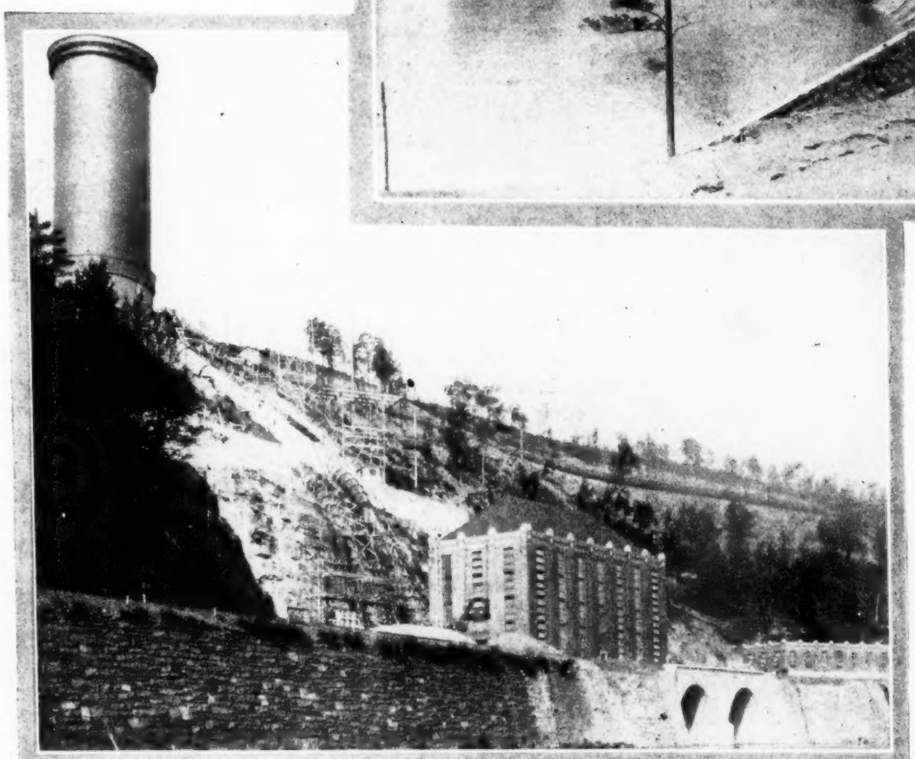
In the field of propeller-type runners there has been considerable activity both in this country and Canada. Contracts were placed for two large units in the Great Falls plant of the Manitoba Power Co., the details of which are given in the part of the review dealing with the Canadian developments. In this country contracts have been let for a number of units ranging in size up to 9,300 hp. and for heads up to 59 ft. Three Bell type units of 9,300-hp. rating under a 50-ft. head are being installed in the Black Eagle plant of the Great Falls Power Company. Contracts were also placed for two 5,000-hp. Moody-type units to operate under a 59-ft. head to be installed in the Maribondo Falls development in Brazil.

Work is progressing on the plant of the Louisville Hydro-Electric Co., on the Ohio River at Louisville, Ky., reported in last year's review. This plant will have an ultimate capacity of ten 13,500-hp. Nagler-type units

Hydro-Electric Plants Recently Completed

Right—Two 120-ft. head 29,600-hp. units installed in the Bartletts Ferry plant, Columbus Electric & Power Co. (Georgia)

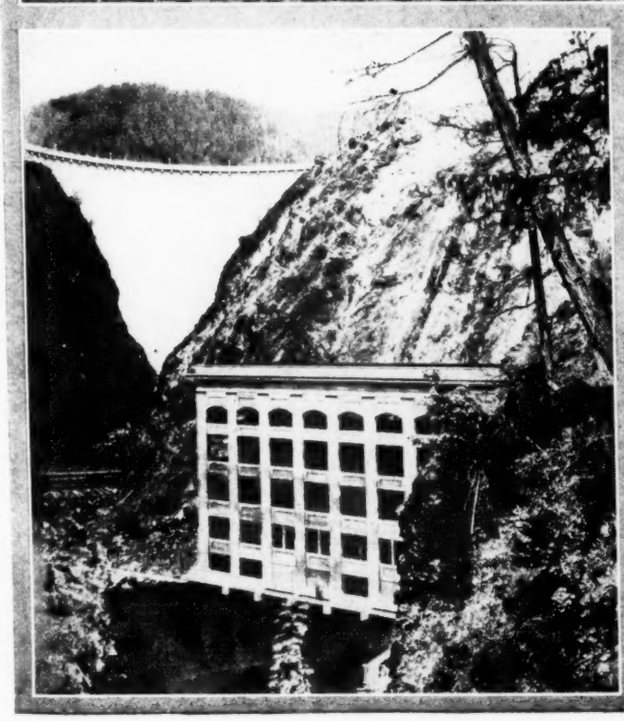


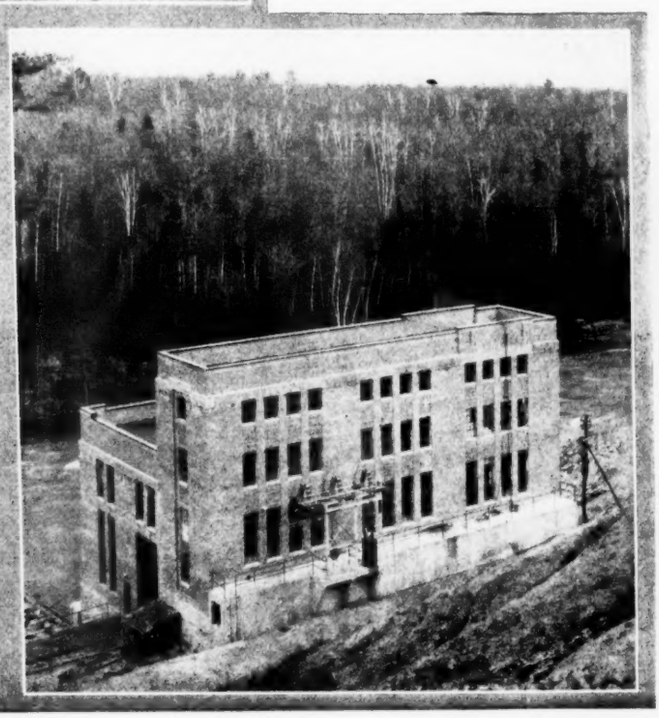


Left—Two 300-ft. head 28,500-hp. units installed in the Wallenpaupack plant, Pennsylvania Power & Light Co.

Lower Left—Cushman plant of Tacoma, Wash., has two 275-head 25,000-hp. units installed

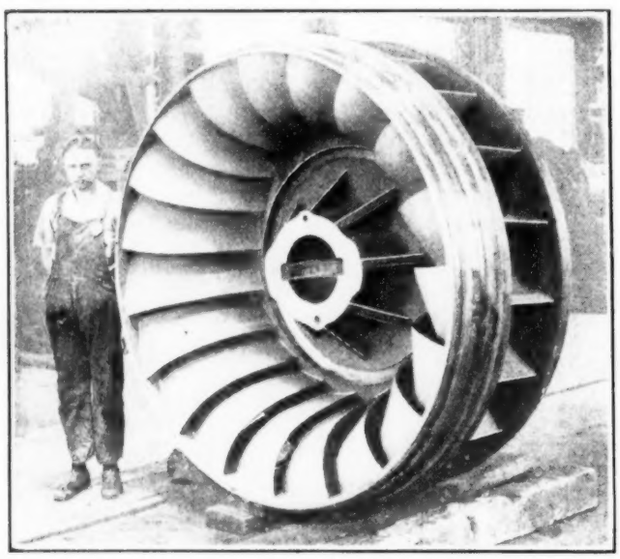
Lower Right—Batiscan plant, Shawinigan Water & Power Co., Quebec, has two 147-ft. head 12,500-hp. units





to operate under a head of 37 ft., eight of which will be included in the initial installation. The runners have a diameter of 17 ft., and will pass 4,000 cu.ft. of water per second. One of the features of this plant is that it is designed for a maximum tailwater elevation variation of 69 ft. The units are designed for a capacity of 13,500 hp. under a 37-ft. head, and they will develop 2,600 hp. when the head is reduced to 12 ft. High tailwater will in an average year prevent operation of the plant for about 45 days.

Among the plants that have gone into operation during the year may be mentioned the Wallenpaupack development of the Pennsylvania Power & Light Co., in which are installed two vertical Francis-type units, each of 28,500-hp. rating, to operate under 300-ft. head at



One of the two 28,500-hp. bronze runners for a 300-ft. head, installed in the Wallenpaupack units

300 r.p.m. These machines have cast-steel scroll cases and bronze runners, with oil-lubricated guide bearings.

Another outstanding plant is that at Martin Dam of the Alabama Power Co. There are three 45,000-hp. Francis unit in this installation to operate under a normal head of 129 ft. The Cheat Haven plant of the West Virginia Power & Transmission Co. was completed during the year; in it there are installed four 18,000-hp. units to operate under an 82-ft. head at 133.3 r.p.m. One of the features of these units is the use of rubber-lined turbine guide bearings.

Automatic hydro-electric plants established another record during the last year in the 17,500-hp. unit to operate under a 190-ft. head in the plant of the Northwestern Power & Light Co. in Washington. Both the main unit and a 62.5-kva. auxiliary waterwheel and motor-driven oil-pump unit will be controlled by the automatic equipment. By means of selector supervisory control, the operator in a station seven miles away will give starting and stopping indications to the automatic control equipment which, in turn, will perform the necessary operations for starting, stopping and protecting the main unit and applying the field to the generator.

There is an increasing use of automatic control for hydro-electric plants, and new methods of applying this system to both the reaction and impulse type of units are being developed. One installation consists of four plants each of two units. One of these plants is manually controlled and the other three are automatically controlled from this plant.

Rubber seal rings and rubber-lined guide bearings continue to attract attention. Experience with those in use has proved so satisfactory that they are being installed in a number of new units under construction. Bearings of this type have recently been adopted for use with four turbine installations in which the shaft diameters range from 9 to 24 in. The chief advantage of the rubber-lined guide bearing is the greater durability and the long life obtainable.

A large number of power companies for which hydro-electric units were installed recently, adopted electric drives for the governors. This form of drive is becoming increasingly popular for hydro-electric installations. The driving motors are of the induction type and operate in close synchronism with the frequency of the generator unit that it is required to regulate. This provides a simple and convenient drive and has been found to give extremely smooth and quiet operation, free from operating troubles.

During the year the Hydraulic Power Committee of the National Electric Light Association issued its report on the pitting of hydraulic turbines, this report representing over two years' work and being based on data obtained from 225 units. The conclusions drawn were to the effect that pitting is caused by a vacuum forming on the surface due to excessive draft head or improper design of the runner. These conclusions conform with those expressed in a preliminary report issued in 1924.

In Canada water-power development continues active, particularly in Quebec and Ontario, and orders were placed for a number of large units during the last year. Among these were two more units for the Great Falls plant of the Manitoba Power Co. One of these units, rated at 28,000 hp., is of the Moody propeller type and is to operate under a 56-ft. head. This will make three of these units in this plant. The fourth is of the high-speed four-blade Bell type and will be rated at 31,500 hp. at 138.5 r.p.m.

Another large contract placed was for three 18,000-hp. vertical-shaft Francis-type units to operate under a 64-ft. head at 100 r.p.m. in the Camp Alexander plant of the Hydro-Electric Power Commission of Ontario. Two other outstanding installations are those being made by the Canadian International Paper Co. on the Gatineau River about eight miles above its confluence with the Ottawa River. In the Chelsea plant of this development there are being installed four 34,000-hp. units to operate under a 93-ft. head at 100 r.p.m., and in the Farmers Rapids plant there are being installed four 24,000-hp. units to operate under a head of 66 ft. at 90 r.p.m. In each of these plants space has been provided for a fifth unit when conditions require this additional capacity.

Two more 50,000-hp. units have been installed in the Isle Maligne plant of the Duke-Price Power Co. at Lake St. John on the Saguenay River in Quebec. This brings the capacity of the plant up to 500,000 hp., with space for two more machines. Work on the Chute A Caron development about 20 miles below Isle Maligne has not progressed very far, although some work has been done, but it will probably get well under way during the next twelve months. This project involves over 1,000,000 hp. in one station.

A Year of Broken Records in the Electrical Power Field

INCREASED demands for power, larger size and higher voltage generators, and motors and other classes of equipment are some of the things that distinguish the year just past.

SO FAR as new developments are concerned, there have not been any in the electrical power field that would make the last year especially notable. Most of the advances made have been with equipment that is more or less standard, to improve its design and increase the range of its application. If there is anything that made the year 1926 stand out from previous ones, it is the number of records that have been broken.

The volume of business has been unprecedented, and the increase in power demands has exceeded any previous year. In 1925 the power generated by central stations was 61 billion kilowatt-hours. In 1926 this figure increased to over 68.5 billion kilowatt-hours. Of this amount over 25 billion kilowatt-hours was from water-power plants.

As previously stated, the size of the generating units contracted for has been one of the distinguishing features of the year. Among these may be mentioned the 188,256-kva. machine ordered by the United Electric Light & Power Company, New York, for its Hell Gate Station. The two generators in the unit are of equal capacity and have a rating of over 94,000 kva., at 13,800 volts 60 cycles. Each machine is therefore larger than any unit in operation at the present time, and larger than any single generator contracted for. One of these generators will operate at 1,800 and the other at 1,200 revolutions per minute.

Largest Turbine-Generator Unit

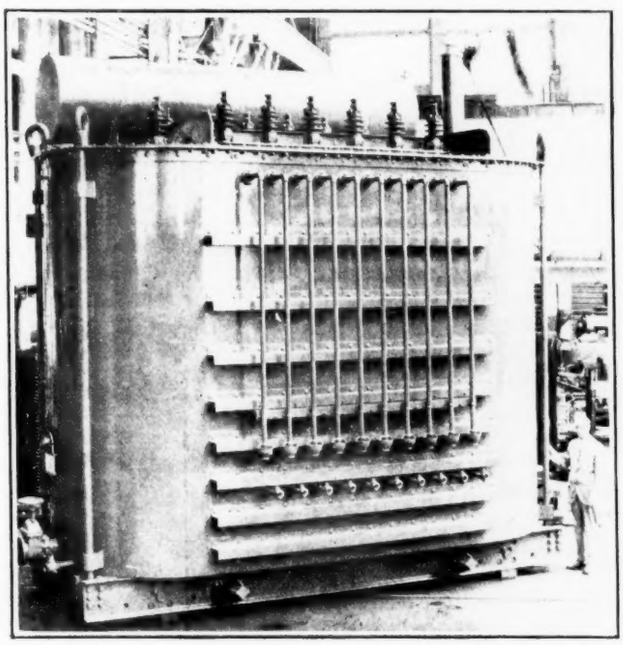
The contract for the Hell Gate machine had been announced for only about two months, when the 235,000-kva. unit for the State Line Power Co., near Chicago, took the record. There are three generators in this unit, one rated at 90,000 kva. and two at 73,000. All three machines operate at 1,800 r.p.m., and although the combined rating of this unit is larger than the Hell Gate machine by 47,000 kva., the individual machines are of smaller capacity.

One of the features of the State Line machine is that it is designed for 18,000 volts. This is higher by about 3,000 than the voltage of any generator in operation or contracted for in this country. Synchronous condensers are in operation on 16,500 volts and induction motors on the equivalent of 22,000 volts. It is reported that two 30,000-volt hydro-electric generators have been in operation in a station at Subiaco, Italy, for a number of years. These are probably the highest voltage generators on record.

A contract was let for a 104,000-kw. unit for the Crawford Avenue Station of the Commonwealth Edison Company, Chicago, which will bring the capacity of this plant up to 450,000 kw. Contracts were also let for two 100,000-kva. turbo-generators for the Southern California Edison Company. These machines are designed for 15,500 volts, will operate at 1,500 r.p.m. and are the largest capacity so far attempted in a single machine. The armatures will weigh 330,000 lb. During less than five months of the last year contracts were let for six machines that had an aggregate rating of over 800,000 kva., and this gives some idea of the vast increase in the size of turbo-generating units.

The largest machine to go into service was the 80,000-kw. unit in the Hudson Avenue Station of the Brooklyn Edison Company. This unit consisted of two generators driven by a cross-compound turbine.

In the hydro-electric field contracts have been let for a large number of units, and although most of them are not record-breaking in capacity, some of them are in dimensions. The seven units for the Conowingo development of the Susquehanna Power Company, although rated at only 40,000 kva., have the largest dimensions of any units so far attempted. They are 37 ft. outside diameter, and the thrust bearing which carries the full weight of the revolving member of each unit is designed for 1,500,000 lb. load.

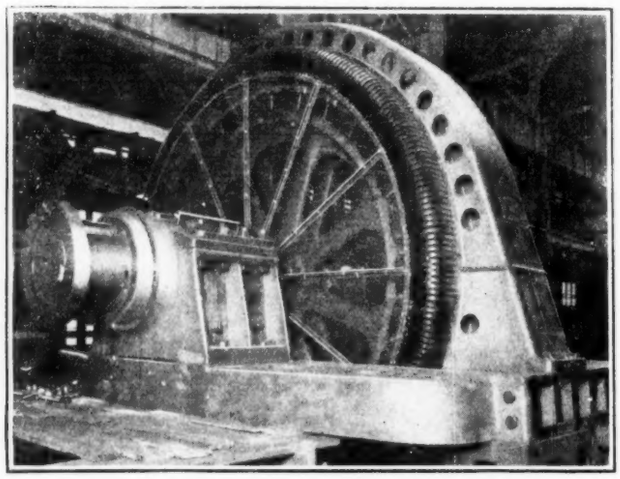


Auto-tranformer rated at 66,667 kva. for stepping up generator voltage to 24,500

The two 50,000-kva. horizontal-shaft units being built for the Southern California Edison Company, to be directly mounted on the shaft of two 56,000-hp. double

overhung impulse-type wheels, are the largest capacity machines of this type so far attempted. In line with the waterwheel orders contracts were reported let for upward of 1,000,000 kva. of hydro-electric generators during the last year. The generally large capacity of these units is indicated by the statement of one manufacturer to the effect that during the last 12 months he had contracted or had on order 30 units rated at 10,000 kva. and above.

In transformers considerable attention has been given



Synchronous motor of 9,000-hp. 6,600-volt rating for driving a steel mill

to tap-changing equipment for varying the ratio while the unit is under load. These equipments have been applied to some large installations, for example, two 32,500-kva. banks. This tap-changing equipment is arranged for manual operation on full automatic control. Automatic control may be by voltage relays, which responds to voltage change on the low-voltage side of the transformers.

Large orders for generating equipment and an active year in interconnection of power systems have resulted in large orders for transformers. One company reports orders for approximately 1,000,000 kva. and has built an equal capacity. Another company reports that at the close of the year it had under construction twenty-eight 220,000-volt transformers aggregating 727,000 kva. At one time in the year it had in process of construction a total capacity of over 2,000,000 kva. in units for 70,000 volts and above. The largest auto-transformer was a 66,667-kva. unit for the Buffalo General Electric Company. This is used to step up the voltage of a 60,000-kva. 12,000-volt generator to 24,500 volts.

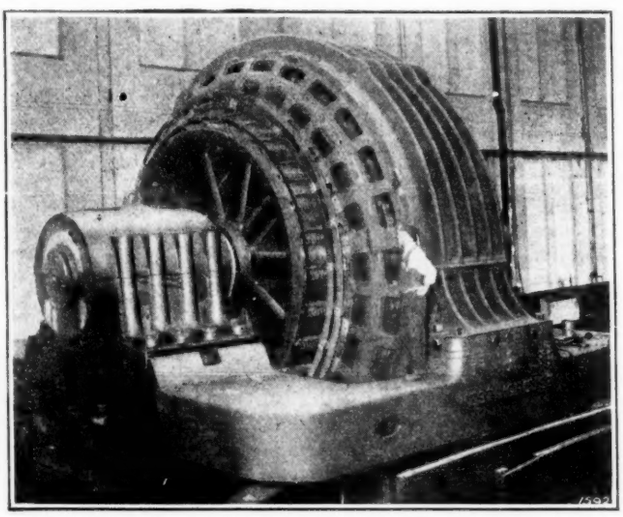
Transformers designed to carry part of their rated load as self-cooled units, and from two-thirds to full load with artificial cooling from a motor-driven blower supplying an air blast over the radiators, are coming into general use. This method of cooling is as effective as water cooling and provides immunity from frozen or leaky cooling coils.

For regulation of large high-voltage systems and for power-factor correction a considerable demand has been created for synchronous condensers, some of them of very large capacity. Three units of this type are under construction, rated at 50,000 kva., and are expected to have the remarkably high efficiency of 98.33 per cent. Frequency charger sets of 35,000- and 40,000-kva. rating are under construction or have been installed during the year. The 35,000-kva. unit is designed to supply both polyphase and single-phase power.

The last year can also record some interesting rotary converters, among which may be mentioned six 13,000-ampere 60 cycle type for supplying three-wire Edison service and one 17,000-ampere 25-cycle unit for the same class of service. Large capacity steel-tank mercury-arc power rectifiers attracted considerable attention in this country, and a number of units were installed ranging in size from 500 kw. at 600 volts to 15,000 kw. at 1,500 volts.

The field of application of synchronous motors continued to widen. The successful going into service of a 9,000-hp. motor of this type to drive a steel billet mill was the crowning achievement. This machine has the largest continuous capacity of any industrial motor so far installed. A number of smaller motors of this type have been put into operation driving rolls in steel mills and orders have been placed for others, among them one of 1,500-hp. and another of 500-hp. rating. A few years ago such service was thought to be outside the field of application for such motors. A recent development is the type with a magnetic clutch built in the rotor so that the motor may be connected to its load after it has come up to speed. Motors of this type up to 900 hp. have been applied to driving tube mills.

A record for size in direct-current machines was established for direct-current motors in one rated at 8,000 hp. in a single armature at a speed of 40 r.p.m. Three direct-current motors of 7,000 hp. capacity were also reported. An interesting wound-rotor induction



Direct-current 8,000-hp. 40-r.p.m. single armature motor

motor, on account of its high voltage, is a 5,000-hp. 13,200-volt machine to operate at 99 r.p.m.

For starting equipment a great deal of attention has been given to the across-the-line type for alternating-current motors. Motors of 500-hp. rating at 2,200 volts have been reported to be successfully started in this way on a system supplied from a 4,500-kw. generator capacity. However, there are many factors that may affect this method of starting, and these should be carefully considered or serious trouble may result. There is undoubtedly a tremendous field for the application of this type of starting and rapid progress is being made.

Engineering Research and Society Activities

TO SOLVE many of the problems that arise in these days of rapid development, the need of pure scientific research is being recognized as never before, and in various phases of the power-plant field extensive programs of research are being conducted into refractories, feed water, embrittlement of steel, welding, boiler-furnace slags, processing and liquefaction of coals, etc.

DURING the last few years this country has been learning the importance of research and the part played by pure science in industrial development. Since the war support given European research laboratories has been diverted largely to more immediate needs, so that the United States must assume the burden of carrying on the work and producing the fundamental discoveries upon which industries are built.

There has been a noticeable improvement in the attitude of manufacturers toward research. They seem to be getting away from the policy of secrecy and are willing to interchange knowledge gained by their own efforts or through their financial support. Engineers and scientists of these organizations are participating in work of common interest, and the interchange of their findings is resulting in a wealth of practical information.

To solve many of the problems that are arising in these days of rapid development, the need of pure scientific research is being recognized. As an evidence the National Research Endowment under the leadership of Secretary Herbert C. Hoover, Elihu Root and Charles E. Hughes is engaged in a campaign to raise $20,000,000 to aid American universities to carry on fundamental research during the next ten years.

In various phases of the power-plant field, extensive programs of research are being conducted. Notable among these is the joint research of five national technical organizations in studying the various processes employed in the purification of feed water and determining the fundamental principles underlying certain phenomena which take place in steam boilers, some of the subjects covered being pretreatment of boiler feed water, foaming and priming, embrittlement of steel, corrosion, etc. This work is now well started. The Bureau of Mines is continuing its scientific attack on scale and corrosion, is studying heat-flow meters for furnace walls and in co-operation with the Carnegie Institute of Technology is conducting a program of mining and metallurgical research, one part of which will be of interest to the power-plant field, as it will cover various phases entering into the utilization of coal.

In co-operation with the special boiler refractories research committee of the American Society of Mechanical Engineers the Bureau is on the second phase of an extended program of investigation of refractories, the purpose being in this phase to provide the user, manufacturer and the ceramic engineer more accurate information than has been available heretofore in regard to conditions met by refractories in service.

To meet a demand for more stamina in steel, scientific research, already under way in England and France, is to be started in America. A joint research committee of three technical societies has mapped out a program of investigations requiring the expenditure of $50,000 and the co-operation of the industries and several of the universities.

To the Engineering Foundation $100,000 was donated by Edward Dean Adams. Two research projects were granted financial assistance, the sum of $4,000 a year for three years being allotted for research in blast-furnace slags and $5,000 a year for two years for research in electrical insulation.

Following the establishment by John D. Rockefeller of an endowment for petroleum research, a series of studies in the origin, distribution and properties of petroleum is to be made under the joint auspices of the American Petroleum Institute and the National Research Council. A fund has been provided to finance the work for five years.

At Pittsburgh the recent international congress summarized the research that had been conducted on the processing and liquefaction of coal and emphasized the need for much fundamental work before the knowledge of fuels would equal that in other fields. Feeling that the highly unsatisfactory present condition of the coal industry would lead the operators to seek, as never before, the help of scientists and engineers in the solution of their problems, Dr. T. S. Baker, president of the Carnegie Institute of Technology, proposed the establishment of a great American foundation for coal research in its most fundamental phases.

New American Standards

Three new American standards to be issued soon deal with spur-gear tooth form, wrench head bolts and nuts, steel flanges and flanged fittings. On the flanges and fittings a subcommittee began work three years ago, when only a few plants were in operation at pressures of 350 and 400 lb. and the first of the 600-lb. stations were being developed. A series of standard pressures up to the critical point, bearing a geometrical ratio to each other, were mapped out and are as follows: 250, 400, 600, 900, 1,350, 2,000 and 3,200 lb. For the first five of these pressures proposed tentative American standards are ready.

Specification for lap-welded and seamless steel pipe for these same pressures and for temperatures up to 700 deg. F. or higher, as proposed by the Prime Movers Committee of the National Electric Light Association and formulated under the procedure of the American Engineering Standards Committee, have been given publicity in these columns. Great credit is due this work, for rarely in the mechanical field has a series of standards been developed in advance of common practice.

Reduction of the number of sizes of wrought-iron and steel pipe, valves and fittings was a question that was considered during the year as a part of the Department of Commerce program on the simplification of product. The boiler inspectors have been urging uniformity in some of the minor differences in boiler construction and in inspection standards. The American Refractories Institute is working on specifications that will consider refractories for the boiler room. These are only a few of the many things that might be enumerated, for standardization is spreading to all branches of the field and to all classes of industry.

International Activities

International activities of an engineering character are continuing. Reference has been made to the coal conference. In April the International Electrotechnical Commission met in New York to hear and consider reports of the various advisory committees on a variety of electrical and mechanical topics. One of the subjects under consideration was the development of international codes for steam and hydraulic turbines to cover both commercial and technical matters. The plan is to develop a code in four parts, one defining certain technical terms, the second presenting an itemized schedule of the information to be furnished in connection with an inquiry or order addressed to a manufacturer, the third setting forth certain commercial considerations that must be observed in testing turbines to determine their conformity with guarantees, and the fourth a comprehensive technical code of testing methods.

In September a power conference was held in Basel, Switzerland, in which thirty-two countries participated and seventy papers were presented, dealing with utilization of water power and inland navigation, hydroelectric and thermal power, power exchange between countries and the application of electricity to railways and agriculture.

Two industrial museums similar to the Deutches Museum in Munich and the Science Museum in London, are now assured in this country—one in New York, for which the late Henry R. Towne left a bequest of more than two and a half million dollars, and the other in Chicago through the magnificent gift of three million dollars by Julius Rosenwald and a larger sum from the city. Located in the two large industrial centers of the country, both of these museums should prove of great educational value.

Honor Roll for 1926

Of the various medals awarded for notable scientific or industrial achievement, the highest honor bestowed by the engineering profession in this country is the John Fritz gold medal established in 1902 in honor of John Fritz, pioneer in the American iron and steel industry. The award in 1926 was to Edward Dean Adams, of New York City, for achievement as "an engineer, financier, scientist, whose vision, courage and industry made possible the birth at Niagara Falls of hydro-electric power."

Late in the year Elmer Ambrose Sperry was nominated and awarded the John Fritz medal for 1927. He is notable for his numerous inventions in the early field of electricity, but is better known in recent years as the inventor of the gyroscope for the stabilization of ships and later for airplanes.

As "America's greatest expert in the chemistry of coal," Samuel Wilson Parr, professor of chemistry at the University of Illinois, was awarded the Chandler gold medal, bestowed annually by Columbia University for achievement in science.

In honor of the Swedish engineer and scientist the new John Ericsson gold medal was established last year by the American Society of Swedish Engineers. It is to be awarded not oftener than every second year to Americans of Swedish birth or descent or Swedish citizens as a recognition of distinguished accomplishments in science and engineering. The first recipient was Dr. Svante Arrhenius, who is considered the father of electrochemistry, the award being made as a part of the ceremonies accompanying the unveiling of the John Ericsson monument in Washington.

One of the important features of the spring meeting of the American Society of Mechanical Engineers at San Francisco was the presentation of the A.S.M.E. Medal to Dr. Robert A. Millikan, executive head of the California Institute of Technology. The award was made on account of Doctor Millikan's unusual contributions to science and to engineering. For more than thirty years he has been known as a physicist and has been author or joint author of at least nine books familiar to every student of physics.

Frank W. Peek, Jr., of Philadelphia, received the Levy Medal of the Franklin Institute.

A British pioneer in electrical engineering and twice president of the Institution of Electrical Engineers, Col. R. E. B. Crompton, C.B., was designated as the fifth recipient of the Faraday Medal.

Sir Charles A. Parsons, perfecter of the reaction steam turbine and noted for valuable contributions along other lines in physical science, was awarded the Kelvin Medal for 1926. This medal was established in 1914 as part of a memorial to the late Lord Kelvin and is awarded triennially for pre-eminence in the branches of engineering with which Lord Kelvin's scientific work and researches were closely identified.

Tribute came to S. Z. DeFerranti, pioneer in the development of the electrical industry, in the form of honorary membership in the British Institution of Electrical Engineers. Of numerous honorary degrees awarded in this country, four prominent men of the General Electric Company were favored: Owen D. Young, chairman of the board of directors, received the degree of doctor of laws from Rutgers College; Dr. W. R. Whitney, director of the research laboratory, and E. F. W. Alexanderson, consulting engineer, who has gained international fame with his radio inventions and developments, were awarded the honorary degree of doctor of science, Doctor Whitney at Syracuse University and Mr. Alexanderson at Union College; A. W. Burchard, chairman of the board of directors of the International General Electric Company, received the degree of doctor of laws from Union College.

Presidential selections in the various societies and associations closely allied to *Power's* field were:

SOCIETY	PRESIDENT
American Engineering Council	Dexter S. Kimball
Engineering Foundation	Lewis Buckley Stillwell
American Society of Mechanical Engineers	Charles M. Schwab
American Institute of Electrical Engineers	Cummings C. Chesney
Association of Iron & Steel Electrical Engineers	S. S. Wales
American Society of Refrigerating Engineers	Willis H. Carrier
American Society of Heating & Ventilating Engineers	W. H. Driscoll
American Welding Society	F. M. Farmer
American Boiler Manufacturers Association	George W. Bach
National Electric Light Association	R. F. Pack
National Association of Stationary Engineers	John Quincy Adams
National Association of Practical Refrigerating Engineers	B. S. T. Dobre
National District Heating Association	J. E. Seiter
Smoke Prevention Association	Glen M. Jewell

Coming

THE files of *Power* for 1926 bear testimony to the marked activity toward improvement in industrial power plant practice, through the installation of new equipment, adoption of higher pressures and better utilization of steam for process. In many cases the savings recorded represented handsome profits on the investment.

Indications point to a continuance of this activity through the present year. Believing that accounts of outstanding improvements and savings serve as incentives to other plant managements and operating staffs, *Power is planning to announce substantial cash prizes for the best articles of this character during the year.* Details of the competition and awards will be announced at an early date.

One of the greatest obstacles to intelligent plant operation and comparison of plant performances is the lack of adequate and uniform operating records. This is especially true of the small plants. With a view to helping engineers of these plants, there will appear during the year a series of articles on keeping plant records. These will start in a most elementary way and work up to the needs of the average plant.

A series of articles on furnace design, to meet the requirements of various fuels, will be helpful to both the plant designer and the operator. The latter will also find several maintenance articles of immeasurable assistance.

There will appear shortly a survey of the oil-engine field, showing the growth in this type of prime mover over the last five-year period; where such engines are being installed; and what types are being applied to various classes of service.

The industrial barometer, recently started in a small way, will be expanded during the year to include several key branches of the power-plant equipment field.

The foregoing are just a few typical titles of articles planned for the coming year; others will be announced from time to time.

Looking Backward

SINCE the art of writing began, there has been a literature of retrospect, penned by those who look with longing and regret upon a golden "good old" past, when all was fair and free from evil. A writer in a recent issue of the *Atlantic Monthly* discusses "The Habit of Going to the Devil," in an article made up entirely of quotations ranging from eighty to a hundred years old, and they all sound like the moanings of many a present-day "crepe-hanger."

The habit of retrospect is deep-seated in the human mind, and when one's point of view is such that present conditions seem bad, it is easy to persuade one's self that bygone days were better, especially when there is no scale for measuring conditions.

But in the field of engineering the picture has a rosier foreground, and there are fairly definite standards for judging and comparing past and present accomplishments. Today is undeniably better than yesterday in respect of technical attainment. And it is fascinating to watch progress year by year. Looking ahead at the opening of a year, it seems improbable that the past rate of advance will be sustained, and yet, when the twelvemonth is over, it is almost startling to see that the march of progress has gone on apace, without blare of trumpets, but in a steady advance.

Who can tell where another year will lead us? Now and then we glimpse what the future may be, but usually our attention must be confined to the task of making sure that today's step is in the right direction and that today's work is thoroughly well done. Sound workmanship is the base and body of genuine development.

As engineers, we can adopt the brief statement of the doctrine of organic evolution, "I believe that today is better than yesterday and that tomorrow will be better than today," and to that end we are bound to devote all the energies we possess. Let optimism be coupled with hard work—that is the philosophy of the engineer.

The Lure of Coal Treatment

MUCH thought and effort have been expended in this country on the development of processes for the low-temperature carbonization of coal. Premature newspaper publicity has excited the popular fancy on this question and has aroused some exaggerated expectations in the public mind with regard to the great benefits about to be derived from such treatment of coal. As a matter of fact, there is no plant in America today that is in full and commercially profitable operation on a low-temperature distillation process, although some appear to be approaching this stage.

The difficulties in developing such processes are many. In the first place, our coals differ widely in character, and European experiences form an unreliable guide to treatment of American coals. Hence processes copied from European ideas have not succeeded here and processes that work on one coal will not necessarily be satisfactory on another. Many inventors have not grasped the economics of the problem and have exaggerated the gains to be obtained by distillation.

In general all processes have either of two objectives —to remove valuable liquid fuels from coal before burning it in furnaces or to produce a smokeless domestic fuel comparable to anthracite. Where coal is stripped of its volatiles only, as in the first case, these must have a high form value to make the process profitable. The gas evolved in certain processes has a high heat value and may serve as a substitute for natural gas or may blend with blue water gas to replace carbureting oil to raise its heat value to certain standards. A portion of the oils from carbonization forms high-grade motor

fuels, but as such, they have to compete with low-cost gasoline. The market for the remaining tar oils is not highly developed in this country. On the other hand, motor fuels command higher prices in Europe and tar oils find a ready market. Thus it is apparent that one cannot base American estimates on European performances.

There would seem to be a more promising future for processes of the second class in providing a smokeless domestic fuel. In cities where anthracite is the predominating fuel, such substitute fuel will probably be readily adapted, provided it does not make objectionable dust in handling and burns equally as well as anthracite. The latter condition may present some difficulties because of the size of fire bed, frequency and amount of firing may differ from present practice with anthracite. Finally, the new fuel must sell below prevailing anthracite prices to stimulate its use, particularly since local prejudice will favor anthracite. This smokeless char will be difficult to introduce in cities where soft coal is now burned in domestic furnaces. Its price will be higher than soft coal, and the average citizen will reluctantly part with his dollar just to keep the atmosphere of his city clean.

Much has been written about the marvelous progress in the hydrogenation and liquefaction of coals in Europe, and many speak disparagingly of our slowness in adopting these processes in America. Here again one finds that economic conditions govern. Alcohols as motor fuel cannot compete with gasoline on an economic basis until the price of gasoline has materially advanced over present-day figures. This advantage may occur at some time in the future, and when it does our enormous deposits of oil shales in the West will probably furnish the needed motor fuels instead of alcohol. Conditions are different in Europe. Motor fuels cost more than here, and furthermore, each nation is trying to develop its own sources of fuel supply in case of another war. However, our industrial uses of alcohol are increasing rapidly and a cheap source of supply from coal by hydrogenation may be needed.

Considerable money is being invested in coal-treatment processes in this country. A note of caution is timely. Investors should not let their enthusiasm get the better of their business judgment, and engineers should be consulted before too much money has been spent on new processes.

Is Size a Mark of Progress?

THIRTY-ONE pages of this issue are devoted to a review of the progress made in the power field, during the last twelve months. Standing out on practically every page are statements to convey the idea of largest—boilers with a larger area of heating surface than ever before built, the largest turbine-generating units, the largest condensers, motors, transformers, and so on. True, many other features are recorded such as equipment involving radically new principles, advance in steam pressures and new discoveries in the field of pure science, but these seem to be overshadowed by the bigness of things attempted in power generation and transmission. One may well ask the question, Does this mean progress?

Power generation by central stations increased seven and one-half billion kilowatt-hours in 1926, over that generated in 1925. This is an increase of over twelve per cent and shows a substantial advance in the application of power. When it is considered that about three million horsepower was required to supply the increased power demands in this country last year, one of the reasons for the bigness of equipment is apparent. It is just part of a healthy growth and is based on sound economic and engineering principles.

To produce a large piece of equipment, the design, manufacturing and operating problems are much accentuated over those involved in apparatus of smaller size. In machines of high rotative speed such as turbine-generators, the design of a two hundred thousand kilowatt unit has a great multiplicity of problems to be solved that do not, in the present state of the art, cause serious concern in the production of a unit one-tenth the capacity. These involve peripheral speed, materials used, expansion and contraction, maintenance of proper clearances, handling of the steam in the low-pressure stages, arrangement of condensers, governing, safety features and many others that require special treatment, and all of which reflect material progress in their solution.

The large modern boilers, including superheaters, water-cooled furnace walls, economizers and air preheaters, burning fuel in suspension and sustaining rates of combustion and evaporation at temperatures, pressures and efficiencies that were not dreamed of a few years ago, represent a progress that the engineering profession may well look upon with pride.

While unprecedented success is being attained in the application of the older and tried principles and methods, it is imperative that the search for new principles, methods and materials be pursued with vigor if the present high order of achievement is to be maintained. It is gratifying that one of the healthiest signs of last year's developments was the increasing interest taken in research by manufacturing companies, engineering and scientific bodies, but the surface has hardly been scratched.

Another Parisian "Discovery"

ABOUT every six months the newspapers report some new "discovery" emanating from Paris. The man making the discovery is generally referred to as a "savant," but "dilettant" or "press agent" would seem a better name in most cases.

Only a little while ago one of these savants reported that practically all of the well-known diseases were caused by vegetables. Each disease has its particular vegetable according to this philosopher. Carrots caused one, turnips another and so on in a delightfully specific manner.

Now comes another report with the exciting heading, "Non-Inflammable Gasoline Tested in France; 'White Spirit' To Increase Safety in Aviation." Perhaps the fault lies more with the author of the article than with the French engineer, Raoul Ferrier, who is carrying on the work. Apparently, the "White Spirit" is not that revered of old by the American Indians, but merely a petroleum fraction between kerosene and ordinary gasolene.

The inventor of the "turnip" theory of disease must rank among the world's most original, if not most careful, men. Mr. Ferrier, on the other hand, has evidently discovered little more than a name, but he has one advantage in that the stuff can probably be made to work.

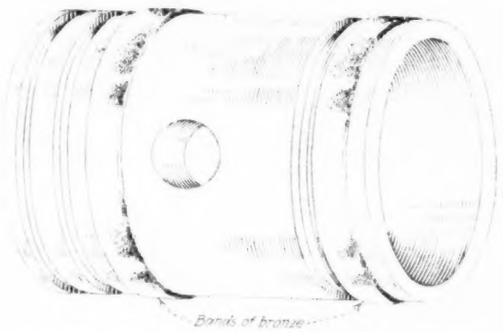
Ideas From Practical Men

Readers are urged to use this department for the exchange of practical operating information. A minimum of five dollars will be paid for contributions accepted

Reclaiming Worn Pistons

In many power houses, factories and shops scattered over the country, heavy-duty gas engines are in use as the source of power. These engines are in almost constant use, and there is always more or less piston and cylinder wear.

In time this becomes of such extent that piston slapping and loss of compression result. One remedy for this is new pistons and rings, but in the case of some of the older engines this may be an expensive repair.



Piston with bronze bands before machining

However, the pistons can be inexpensively reclaimed with the oxyacetylene welding torch. The repair is made by simply laying bands of bronze around the pistons and machining the whole to fit the cylinders.

The pistons are washed with gasoline to remove all the grease and dirt, and when all the gasoline has evaporated, work with the torch may be started. The pistons are laid on their sides on a welding table or suitable workbench.

The thickness of the iron and the experience of the operator will determine the size tip to be used, and a slightly reducing flame, one containing a slight excess of acetylene, will give the best results. A portion of the iron on the top side of the piston is brought to a dull red heat, and the end of the bronze rod that has been warmed and dipped in flux is placed under the flame. A thin layer of bronze is flowed on and as the work progresses, the piston is turned until a ring of bronze is completed around the piston, the bronze rod being dipped in flux as often as necessary.

Two bands of bronze, as shown in the drawing, will give satisfactory results. They may be of any desired width, and of course the wider the bands the better the bearing surface. However, the welder should not work too close to the heavy parts supporting the wristpin or to the top of the piston, as there may then be some distortion caused by the expansion and contraction of the metal.

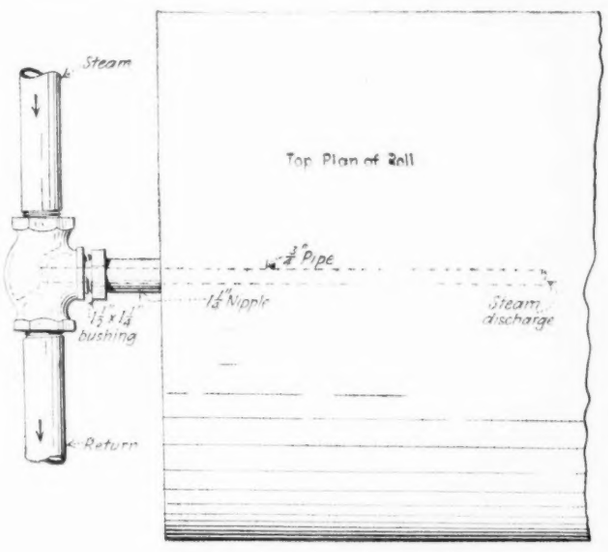
When the pistons have cooled, they are set up in the lathe and machined to fit the cylinders, which have been "miked" so that an exact fit is secured. In installing the piston, new rings are of course required. Once in use it will be found that the bronze-banded pistons will wear even better than new ones.

Only the best grade of bronze and flux should be used on this type of work. It has been my experience that either Tobin or Hungerford bronze gives good results and is of uniform high quality and that Lightning flux is excellent for the bronze welding of cast iron.

Clearfield, Pa. J. F. ELDEE.

Improving Steam Circulation Aids Production

Trouble was experienced on a number of paper calenders owing to slow heating of the rolls, and the increasing of the steam pressure did not seem to improve matters. For this reason the superintendent started these machines half an hour early each morning and allowed the rolls to heat by friction. As each calender was driven by a 60-hp. motor, the increase in the cost of current was noticeable. The center roll of each



How the roll was repiped

machine had a ¾-in. steam connection, and the water of condensation was supposed to drain out through the same connection and then out the cross outlet of a tee, the steam entering the run of the tee.

Conditions were unfavorable for the rapid venting of air and discharge of condensation, which was the cause of the trouble. After finding that the opposite end of the roll could not be drilled for a return line, I used the following method: The bonnets were removed from several old 1-in. brass valves and the seats were tapped out with a ¾-in. pipe tap and a 6-ft. length of

¾-in. pipe screwed into the seat. Next a 1½ x 1¼-in. bushing was screwed into the opening in place of the bonnet, being slipped over the ¾-in. pipe. To do this with a different thread on the bushing from that on the valve bonnet, it was only necessary to take advantage of the fact that the bushing was much harder than the brass valve and by exerting pressure while turning with a wrench, the bushing cut its own thread, going in about two turns. The valve was then taken to the machine and after slipping the ¾-in. pipe into the roll through the 1¼-in. nipple that projected from the end of the roll, the small end of the bushing was screwed on the 1¼-in. nipple. The inlet side of the valve was connected to the steam supply, and the other end of the valve was piped to the return line leading to a trap.

In operation it functioned very well. The steam on the inlet side passed up under the valve seat and entered the roll through the ¾-in. pipe that was screwed into the seat, discharging at the far end of the roll instead of just inside the entrance, as formerly. Thus all air and condensation was forced toward the inlet without interfering with the entrance of steam and passing over the valve seat out the outlet side of the valve. It can be seen that the incoming steam flow does not block the free discharge of air and water as the steam does not come in contact with air or water till it has reached the far end and then it travels in the same direction as the air and water, thus eliminating cross-currents. After leaving the roll, the air or water does not come in contact with the steam, as they travel in separate channels, the steam in the small pipe and condensation and air in the jacket formed by the insertion of this pipe into the 1¼-in. pipe. The same idea could be applied to large radiators where better circulation is desired.

Thompsonville, Conn. G. H. HART.

Unprofitable Repairs in the Power Plant

The question of repairs and upkeep of a plant is a never-ending source of worry to the superintendent not prepared, or qualified, to deal with the matter as a serious one requiring close and continuous attention.

Of course we have some plants where the engineer's greatest trouble is to get anything, even necessary replace parts, but such plants are rapidly disappearing, owing to the realization that, if they are to stay in business, they must receive the proper attention. In the majority of plants it is left to the judgment of the engineer whether repairs are to be carried out or new equipment added, and it is upon this point that many fail to grasp the true position. Some I know go blindly on and even pride themselves on the "savings effected" in repairs, which in reality are unprofitable both to the firm concerned and themselves. When found out and put out, they blame everything but themselves for their position.

I have in mind two instances where the repairs cost practically as much as new equipment—one where a new engineer endeavored to repair an antiquated power transmission gear, and another where extensive repairs were made to an economizer. In both cases considerable money was spent for only a patched-up job at the best.

No doubt many similar cases could be cited, all pointing to the fact that often the engineer and not the firm must carry the blame for much unprofitable repair work and the resulting out-of-date plant, and the remedy lies with them, by altering their views on matters of repairs. In carrying this out, much helpful advice and assistance can be obtained from the plant equipment manufacturers, all or nearly all being willing, when particulars are given them, to supply guaranteed performance or saving in addition to fixed prices. Armed with these, the engineer can in most cases see at a glance whether it should be repairs or a new plant and relieve himself of all responsibility by placing the onus upon the management to decide, always with due regard to the possible extras that may occur when undertaking repairs.

Another point often overlooked in unprofitable plant repairs, particularly by the young engineer, is the fact that most plant equipment manufacturers endeavor to balance the life of the various parts of their equipment, and to find that repairs are required in one part generally means that other parts are approaching a similar condition, and the warning should be noted that the whole requires replacing, instead of tinkering with repairs that can only be unprofitable. A good deal of present-day equipment without doubt pays its cost many times over and often in a very short time. The engineer who grasps this fact, and is ready at all times to place before his firm actual figures showing how repairs mean losses, and new up-to-date equipment an investment that will bring a greater return for capital invested than anything they can suggest, may rest assured that he will not have to look long or far for employment, as many firms could find room for "that sort of engineer."

Belfast, Ireland. F. P. TERRY.

Machining the End of the Packing Gland Concave Makes It More Effective

In our plant there are several asbestos-packed plug cocks that have been in service for 25 years. Recently, one of the cocks began leaking badly around the plug. When the gland was removed, it was found to be turned square on the inner end.

None of the old packing was removed, but an endless ring of ¾-in. round packing was made and inserted on top of the old packing, and the gland was put in a lathe and turned concave. The cock is now practically tight, as the shape of the gland forces the packing inward and tightens it around the plug as the nuts are screwed down. W. H. WAKEMAN.

New Haven, Conn.

ACCORDING TO RALPH A. SHERMAN, the principal difficulty with refractories in underfeed stoker-fired furnaces burning Eastern bituminous coals is the adhesion to the walls of slag from the coal ash. This slag builds out on the front and side walls, reducing the grate surface and obstructing the movement of the fuel. The accumulation on the bridge wall causes bridging of the slag and clinker over the dump plates. If the softening temperature of the ash is low or the furnace temperatures are extremely high, owing to high ratings or low excess air, the slag may become so fluid as to erode the front and side walls. It is also generally accepted that a reducing atmosphere will favor slag erosion. Two furnace accessories are commonly used for the purpose of lessening the difficulty with slag. They are: (1) Inclined side-wall tuyeres or air backs, and (2) ventilated refractory blocks.

Comments from Readers

"Byproduct" Power

We publish a pamphlet entitled "Combined Power and Heating," on page 17 of which are related "Instances of Less Fuel Being Used for Combined Power and Heating Than Previously for Heating Alone."

I am writing because, unless I am mistaken, the case of the small back-pressure turbine, saving $4,080 in eight months as given in your issue dated Nov. 16, 1926, is yet another instance of this puzzling experience. As I read it, although in 1926 there were 20 more working hours and 15,964 more roofing units produced, and in addition the turbine generated power worth $2,898.10 at the rate charged by the outside supply, yet the quantity of fuel oil burned in the first eight months of 1926 was 582,500 gal. with combined power and heating, as compared with 616,000 gal. for the corresponding period of 1925, when steam was raised for heating only and power purchased from the outside. This is 5½ per cent less, indeed about 7 per cent allowing for the greater output, and yet in the face of this and numerous other cases of the same sort, engineers and others, in considering combined power and heating, will insist upon 5, 10 or even 20 per cent being debited for the supposed loss in the heating value of the steam in passing through the engine or turbine.

ALBERT CHARLES TAIN, M. I. Mech. E.,
Bellis & Morcom, Ltd.

Birmingham, England.

The Engineer's Footprints on the Office Carpet

The article "How Do You Meet Your Executive?" in the Nov. 9, 1926, issue caused me to wonder if this was another new study in engineering we would have to become expert in to be a success. It has been my experience that the chief engineer's personal appearance in the small isolated power plant has little to do with holding his position, especially where the manager has come up through the ranks. The duties of the engineer are such that it is almost impossible for him to keep himself looking spick and span.

The article brought to my mind something that happened several years ago when I was holding my first job as engineer in charge. I had been asked by the manager to give him a written report on a condition existing in our plant. I was anxious to show him what a wonderful engineer I was. After I had my report and data arranged by staying overtime, I took them into the manager's office, but he had gone home. The next morning my telephone rang shortly after the manager came in, and of course I was all set for some favorable comment, but to my surprise he asked if I had a horse with me the night before when I was in the office; he said that the floor was a mess.

However, my experience since that time causes me to believe that if the engineer can place before his manager a worth-while plan for reducing the operating expenses, his foot tracks, dirty collar and unkempt hair will be graciously overlooked. When the chief engineer changes his clothes or makes special preparations to go into the manager's office it has, in my opinion, an unfavorable reaction on his subordinates. I have often been called into the office just after making some inspection or doing some repair work. Now what can be done for one's personal appearance on short notice?

I was once employed as sales and service engineer, and while in that position I came in contact with many different types of engineers and managers. I also discovered that one of the most common shortcomings among industrial power-plant engineers is timidness while in the presence of executives. When an engineer is asked his opinion of a certain condition, he tries to answer in a way that will be pleasing to his executive, which makes his engineering experience and knowledge of no value to either his employer or himself. The timidness of the average engineer in making recommendations for modern improvements, due to the conservative ideas of the manager, is doing much to put the isolated plants into disuse. C. W. JEFFERY.

Erie, Pa.

Steam-Jet Ash Conveyors

I was much interested in the article on steam-jet ash conveyors in the Oct. 19, 1926, issue, by C. G. Alexander, and also the one by Eugene Hahn, in the Nov. 16, 1926, issue. Mr. Alexander appears to have covered the situation regarding this type of equipment quite well. His reference to faulty steam-nozzle design is of particular interest in view of the fact that most of the nozzles in use in this type of equipment today are very similar. It is doubtful whether much improvement could be accomplished through any change in this design, because the form of application in itself imposes limitations that cannot be overcome no matter what the design of the nozzle may be.

Mr. Hahn, in commenting on the leaks to which Mr. Alexander refers, implies that these pertain to deficiencies in design of component parts of the conveyor. He probably does not mean this, as no designer would deliberately incorporate a leak, which he knows to be damaging in its effect, in a fitting or part.

Mr. Hahn is correct in his statement to the effect that excessive maintenance has been another justifiable cause for objection in the past. It is doubtful, however, whether the substitution of one material for another in the manner which he suggests could be made to show a perceptible reduction in maintenance costs. It is my conviction that three important factors contribute to low repair costs: First, correct design of fittings entering into the assembly; second, correct design of the entire assembly; third, quality of material of which the equipment is made. To enable the carrying out correctly of a steam-jet conveyor design, a thorough knowledge of the fundamental principles of this method of conveying is essential, plus first-hand experience,

from observation, with the behavior of the material in the various stages of its progress from the time it is fed into the apparatus until it is finally lodged at the ultimate disposal point, whereby due consideration may be given to all the factors entering into the operation and correct provision made for them.

In his article Mr. Hahn speaks of the dust and noise which were usual accompaniments of steam-jet conveyor operations. Elimination of noise is not a major problem, revolving itself into correct and simple means of muffling. With regard to the elimination of dust, Mr. Alexander's suggestion would be found, if carried out correctly, to work out to much better advantage than that of Mr. Hahn, the latter being that a judicious application of an effective spray nozzle be made. In his article he supplies the answer to the objectionable feature of this method, stating that this contributes moisture to the ashes. Judicious application of spray would be rather difficult of accomplishment when considering the class of labor employed for ash handling. Injection of moisture from any other source excepting that small amount which the ashes would receive normally in a properly designed system from the steam with which they come in contact, is not only reprehensible but inevitably productive of a condition in the ash storage tank which would make their discharge into trucks or cars extremely laborious and costly.

Wet or moist ashes will pack, and when one takes into account the weight of a column of ashes in a storage tank, it is not difficult to account for the lack of flow when the discharge gates are opened at the bottom. During cold weather the additional factor of freezing must be considered. Mr. Hahn states that it becomes necessary to design tanks that would minimize the friction of wet ashes within them. This would imply the adoption of a slope at the bottom on which ashes would slide. Such a design would not necessarily mean an improvement, as forces set into action by sliding ashes would result in a pressure at the converging or discharge point which would result in bridging. Mr. Hahn evidently failed to take this into account.

With regard to thawing out the frozen contents of an ash tank by means of a steam coil, this is rather costly and only adds to the expense of operation. Also, it is a curative instead of a prophylactic measure, and the latter is the type that should be adopted in connection with all steam-jet ash handling equipments.

Chicago, Ill. S. BROOKS.

Expanding and Closing in Oil-Engine Piston Rings

In the Nov. 16 issue W. E. Warner describes a tool for removing piston rings which is in more or less general use. It is the usual practice, however, to break the old rings off rather than to employ any special tool to facilitate their removal.

In this same issue is shown a tool for closing piston rings on oil engines. Although a device of this kind might be practical, it should not be necessary where the end of the cylinder bore is flared as it usually is in a well designed engine.

The engine section shown by J. M. Bloomfield reminds me of a similar construction with this difference—the liner was made short about ¼ in., so that there was a recess to retain a gasket that could not be blown out owing to the ridge retaining feature.

It is good practice to have the head end of a piston ring pass the end of the bore so as to avoid a ridge due to cylinder wear; that means the upper flange of the piston groove plus the amount that the piston ring overruns the end of the bore must be provided for.

With the design of a cylinder, as shown by Mr. Bloomfield, a piece of cord could be used to compress the rings and enter them one at a time and in the case of large pistons a piece of tie-wire may be used or even an iron band the ends of which are bent outward to provide for a small clamp or bolt. JAMES MCINTOSH.

Cleveland, Ohio.

Modern Industrial Power Plants Now in Position To Compete with the Central Station

It appears to be the opinion of many engineers that plants will gradually change over to central-station service, thus making operating engineers' jobs fewer each succeeding year. In support of this contention they cite numerous plants that have done so in the last ten years. But if they will take the trouble to look up the number of steam-engine or turbine installations in industrial plants in the last four years, it will be evident that there is no danger of central-station service injuring the operating engineer for some time to come. More plants will undoubtedly change over, but fully as many will change back after the costly experiment with central-station service.

A recent conversation with a consulting engineer brought out the fact that his firm had sufficient contracts to keep them busy for the next ten years building power plants for industrial concerns. The majority of these plants were to replace purchased current, all of the proposed plants to be ready for operation as soon as the existing power contracts expired, which time varies from one to ten years. In some cases power can be generated cheaper, which is good reason for installing a power unit. In other cases the production loss due to shutdowns is the reason for going back to the private power plant, and last but not least, there are many firms that have been induced to sign a contract by superpower arguments. We need not look far to find a few plants of the latter class. A small paper mill in this state was offered central-station service, and as their engine was too small and obsolete, they accepted. The rate offered was 2½c. but they were promised a rate of 1½c. provided they would scrap the engine. This move made it more difficult for them to go back to power generation again, but they did not see the point at the time. Their contract made in 1917 expires in 1932, and according to good authority it will not be renewed even if the rate is again cut.

In a certain large department store that had its own plant, the chief engineer figured power costs closely and on two occasions turned down offers for central-station service. In spite of the refusal the central-station company ran its transmission line right up to the property, and in some mysterious way the chief engineer was discharged. An engineer who had always boosted central-station service took the job, and inside of six months the engines were removed and a power contract signed. At the end of the first year the store had lost $35,000 by increased power costs, but they must live up to their contract.

A coated paper mill was buying power for 2.8c. per

kw.-hr. They were contemplating the installation of a power unit. When the power company heard of it, they cut the rate to 2c. The proposition of generating still looked to be favorable, and the contract was signed for the engine. Another rate cut to 1.6c. was made and an unknown party offered the power customer more money for the engine than he contracted to pay, so the project of generating was abandoned. However, owing to power interruption the purchaser is far from satisfied and has signed up for only five years instead of a much longer service as urged by the power company.

Another paper mill operating twelve paper machines, purchased the power for operating the beater room, rag room and finishing room. But after experimenting with purchased power on one paper machine, they decided against using outside power for paper-machine drive. The cost of operating back-pressure engines exhausting to the drier is only half a cent per kilowatt, or half of the lowest rate given by the power company. In the other departments no process steam is needed and power interruptions are not so disastrous, hence the plan of buying power for those departments. But in the machine room lower costs and more dependable service results from generating this block of power, to say nothing of the increased production and better grade of product.

Another factor to consider is the type of boiler and engine available today and those of 10 or 15 years ago, when many present-day contracts were signed. Today high-pressure boilers and engines are available and there are on record engines operating at 300 to 350 lb. initial pressure and 15 lb. back pressure, showing lower steam rates than the condensing engines of a few years ago. This means that a plant formerly using 1,000 hp. at 14 lb. per hp. condensing and as much more steam for process work at 15 lb., can cut the steam flow in half by using high-pressure equipment and exhausting at the process pressure. Old hand-fired boilers operating at 60 per cent efficiency must in the course of time be replaced. When time for replacement comes, there will be installed in their place, high-pressure water-tube boilers, fired by stoker or powdered coal, and with losses reclaimed by air heaters, 85 per cent efficiency will be obtained. In view of all these developments the industrial power plant is in my opinion in a better position today than ever before to compete with the central station. But the operating engineer must keep up with all these developments by studying engineering journals, or he may find in future that the higher-grade operating jobs are out of his reach.

Springfield, Mass. A. F. SHEEHAN.

Smoke Abatement Is Reviving

The editorial comment in the Dec. 7, 1926, issue on "Smoke Abatement is Reviving," was read with interest, and I am glad to note that such bodies as the A.S.M.E. and the International Coal Conference have again taken up this important matter.

It really seems strange that in this enlightened engineering age we should do so little along permanent constructive lines to improve the smoke nuisance and especially so among the engineering bodies of which we have so many.

You speak of the problem of getting people to change their traditional ways of doing things, and you state that the work cannot be done by a few paid men, but that every engineer must enlist in support of the cause. Not only engineers must enlist, but architects, business men and statesmen. A vast majority of all the coal-burning plants are laid out by architects, and engineers have had little to do with them in the making. Many of the smaller plants are so spoiled in the making that the only cure apparently lies in the direction of making over the coal before it is offered for use in these plants. In other words, extract the smoke from the coal before it is offered for sale.

It is really surprising how many engineering monstrosities are foisted upon the unsuspecting public year in and year out, and the engineering fraternities sit calmly by and do nothing about it. And some of these monstrosities can be found in goodly numbers in fairly good buildings architecturally and of comparatively recent design.

The smoke problem is a man-sized job for any large city to solve, but it never will be solved while it is handled as it is.

Just as long as an arbitrary hole is set aside for a boiler plant and an arbitrary chimney provided, which suits some convenient notch in the building wall irrespective of the amount of hot gases it has to handle, just so long will we be smoking.

If a first-class stoker, reasonably priced, were offered today which would handle smokelessly a fair grade of bituminous coal, it would fail of its designed accomplishment because it could not be properly installed in thousands of existing plants. And to remodel the plant to make it reasonably smokeless would in many cases cost more than a complete new plant.

The smoke nuisance is an engineering problem of the first magnitude, and the engineering bodies of the country have done less about it in a big broad way than the doctors or the lawyers who know nothing about it.

You speak in your editorial of the problem being to a large extent an educational one. If that be true, and I think it is, it seems to me that a good place to start would be on some of the schoolhouse heating jobs and inject into these some real honest to goodness engineering and a little less tradition and politics. Of course, in most public work it is rather difficult to let contracts on a basis of quality and as a rule such work must be let to the lowest responsible bidder. Many public specifications are so drawn that most anything under the sun can be offered, and again we find they are so narrow that they bear the earmarks of some favored thing to the exclusion of all others good or bad, as the case may be.

One does not have to walk far in many of our cities to find a chimney on a public school or other public building contributing a liberal portion of black smoke to the fair neighborhood.

A public building manned by publicly paid employees, designed and paid for with public funds contributing dense black smoke to besmirch the city in which it stands, looks bad. But it is done every day and as Coue said "in almost every way," but you do not hear of any engineering societies actively protesting about it—certainly, not very loudly.

The engineering profession occasionally complains that it does not rank so high in the public esteem as some of the other professions such as the law, medicine or architecture, but in the face of such things as are here cited, maybe there are good reasons for it.

More power to you, Mr. Editor, on the smoke problem. Keep up the good work.

Milwaukee, Wis. EGBERT DOUGLAS,
Consulting Engineer.

News in the Field of Power

Gatineau Hydro Development Nearing Completion

On the Gatineau River in the Province of Quebec and about nine miles from the City of Ottawa, Ontario, one of the largest hydro-electric developments in Canada, is being rapidly carried to completion by the Canadian International Paper Company. Two of the important sections in the project are the power plants at Farmers Rapids and at Chelsea, which are about 1½ miles apart.

The picture shows the condition of the Chelsea development on Dec. 18, looking at the upstream side of the power house and dam. A dam 109 ft. high will back the water up the river about 12½ miles and give a head of 93 ft. at the plant. Space is provided in the station for five 34,000-hp. vertical-shaft single-runner Francis type units, in concrete scroll cases. Four units are being installed and the parts for the fifth unit that are embedded in the concrete. Two units are in place and the third is well on toward completion. It is expected that the first unit will be ready for operation in about one month.

Second Unit Under Way

At the Farmers Rapids plant, about 1½ miles below Chelsea, the head will be 66 ft. In this plant four 24,000-hp. single-runner vertical-shaft Francis type units are being installed in concrete scroll cases, together with the embedded parts for a fifth unit. The installation of the first unit in this plant is practically completed and work on the second is well under way.

With the four units installed in each station, the available capacity will be 232,000 hp., and when the fifth units are completed, the normal rating will be 290,000 horsepower.

A large part of this power will be used in a new paper mill the company is building in that district. This power will not alone be used to drive the mill, but also for the production of steam. There are being installed three 42,000-kw., and one 21,000-kw. electric steam boiler for this purpose. These boilers are to operate at 6,600 volts.

Engineering Council Founded for New York State

The formation of a new engineering body in the State of New York to be known as the New York State Engineering Council was favorably discussed at a special conference of engineers and technical men meeting in Syracuse, N. Y., Dec. 29.

Following several years favorable opinion among A.S.M.E. delegates of each of the New York State sections of the society to the annual meetings, the desirability of forming such a federation to integrate thought and contact of the engineering and allied professional bodies of the state, with especial reference to technical and governmental problems, has been growing steadily among the various engineering groups and affiliations.

Sixteen Societies Represented

At the suggestion of O. L. Angevine, executive secretary of the Rochester Engineering Society, the present meeting was called into session, H. E. Bean, president of the Technology Club of Syracuse, arranging for the representatives to gather at the Technology Club of Syracuse headquarters in the Onondaga Hotel. There nineteen members of sixteen societies in the state gathered from seven cities and passed on the resolution.

The committee, headed by Mr. Bean, assisted by Mr. Angevine and L. W. Wallis, executive secretary of the American Engineering Council, Washington, D. C., steered the procedure of the session. It was decided that this committee choose a chairman and organize a subcommittee to draft a constitution and bylaws to be submitted to all state bodies prior to the final organization conference. The time and location for this meeting will be decided on and posted by Mr. Beans's committee.

From the manifestations of Wednesday's gathering, reported enthusiastic, valuable results will be early realized.

Merger of New York Power Firms Approved

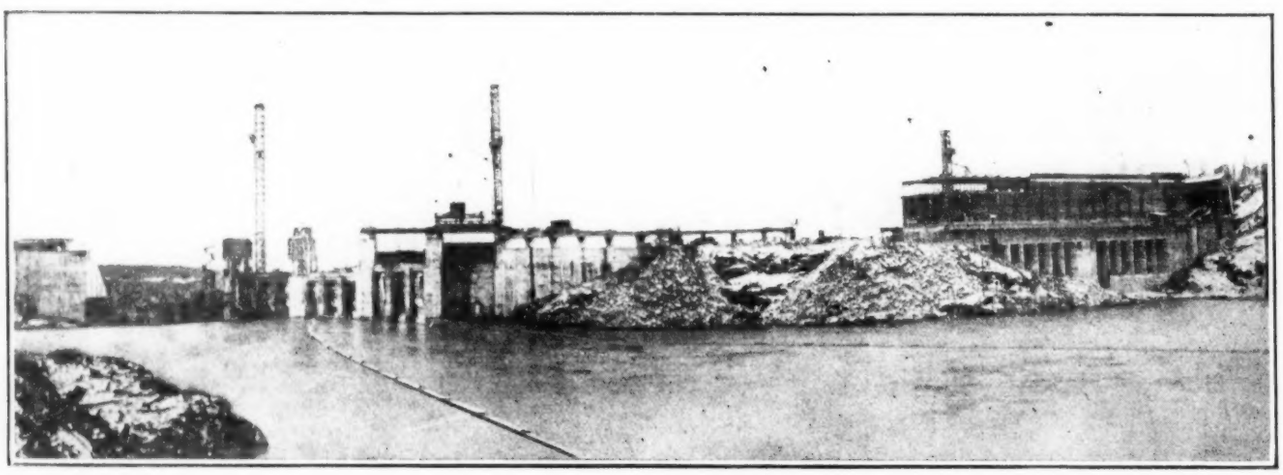
The New York public service commission authorized Dec. 22 the Central Hudson Gas & Electric Co. of Poughkeepsie, the Dutchess Light, Heat & Power Co. of Rhinebeck, the United Hudson Electric Corp. of Poughkeepsie, the Kingston Gas & Electric Co., the Ulster Electric Light, Heat & Power Co. of Saugerties, and the Upper Hudson Electric & Railroad Co. of Catskill to consolidate into a single corporation, to be known as the Central Hudson Gas & Electric Corp.

Consent also is given the Central Hudson Gas & Electric Corp. to exercise all franchises, rights and privileges of the six constituent companies.

Engineering Standards Body Holds Annual Meeting

At the annual meeting of the American Engineering Standards Committee Dec. 9, Charles E. Skinner, a representative of the American Institute of Electrical Engineers, was re-elected chairman for the year 1927.

Charles Rufus Harte, representative of the American Electric Railway Association, was re-elected vice-chairman.



View showing up-stream side of 170,000-hp. Chelsea development in the Canadian International Paper Company's Gatineau project

Duquesne Plans Two Units for Colfax Station

One of the largest power expansions so far carried out or under plan in the greater Pittsburgh area will be undertaken in the near future as a result of the placing of a second contract for a 48,500-kva. turbine-generator unit to be installed at the Colfax Station of the Duquesne Light Co. by the Byllesby Engineering & Management Corporation.

This is the most important plant operated by the Duquesne Light Co. which, according to the announcement made Jan. 1, ordered the two huge units from the Westinghouse Electric & Manufacturing Co. The first order was placed several months ago.

In addition to the two turbine-generators, which will have a combined output of approximately 120,000 electrical horsepower, the contracts call for two steam condensers of 62,500 sq.ft. each as well as a 100,000-kva. bank of electrical transformers to operate at 84,300 volts. Included in the auxiliary equipment are 26 circuit breakers, 10 of which set a record for this type of apparatus. These, having the largest interrupting capacity of any breakers ever built, are rated at 2,650,000 kva. rupturing capacity, at 11,000 volts. Including the main generating units and all auxiliary equipment the two contracts call for a total outlay of approximately $2,000,000.

At the present time there are in operation at the Colfax Station four turbine-generator units totaling 210,000 kva. When installed next year the two additional units will raise the generating capacity to a figure approximating 300,000 kva.

A.S.M.E. Plans Spring Meeting at Virginia Resort

As a departure from the traditional practice of the American Society of Mechanical Engineers, the 1927 spring meeting will be held at a famous resort which is far removed from sights and sounds of industrial activity.

This meeting will be held at White Sulphur Springs, W. Va., May 23-26 inclusive, and the headquarters will be at The Greenbrier, the unusual facilities of which will be at the full disposal of the A.S.M.E. members and their families during the meeting.

The mornings will all be given up to technical sessions and promise is given of a full program of papers.

Full advantage will also be taken of the facilities for social enjoyment, to which the afternoons and evenings will be dedicated. A sports committee representative of all the local sections in the East is being formed to take care of this part of the program.

Savannah Electric Installs New Turbo-Generator

The Savannah Electric & Power Co., of Savannah, Georgia, recently put into operation a new 15,000-kw. turbo-generator.

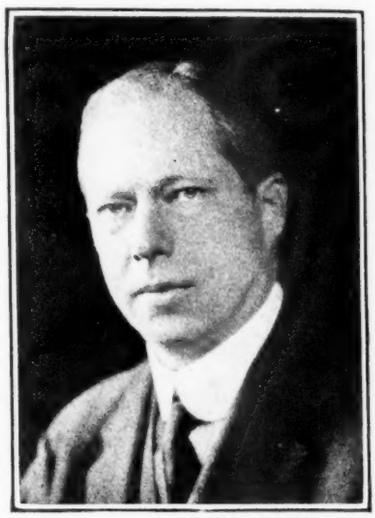
This installation, together with that of two 400-hp. pulverized-coal-burning boilers, is expected to effect material savings in operating costs of the company, which is a subsidiary of the Engineers Public Service Co.

Stone & Webster, Inc., designers and engineers, directed the installation.

Gherardi To Head A.I.E.E.—Other Nominations

Nomination of Bancroft Gherardi, vice-president and chief engineer of the American Telephone & Telegraph Co., New York, to the presidency of the American Institute of Electrical Engineers, to fall vacant Aug. 1, 1927 was, among other office selections, made known recently by the national nominating committee.

Mr. Gherardi was born in San Francisco, April 6, 1873. He was graduated from Cornell University with the degree of M.E. in 1893 and degree of M.M.E. in 1894. Entering the employ of the New York Telephone Co. in 1895, in 1899 he was made traffic engineer of that company. In 1901 he became chief engineer of the New York & New Jersey Telephone Co., serving in that capacity until 1906, when he was made assistant chief engineer of the New York Telephone Co. and New York & New Jersey Telephone Co. In 1907 Mr. Gherardi was appointed equipment engineer of the American Telephone & Telegraph Co. and in 1909 engineer of plant, in which capacity he served until 1918, when he was appointed acting chief engineer and shortly thereafter chief engineer. In April, 1920, he became vice-president and chief engineer of the American Telephone & Telegraph Company.



Underwood & Underwood

Bancroft Gherardi

Mr. Gherardi's activities with the American Institute of Electrical Engineers include: Associate, 1895; fellow, 1912; manager, 1905-08 and 1914-16; vice-president, 1908-10. He has served upon various committees, including the Edison medal, telephony and telegraphy, papers, finance, membership, organization of technical committees, constitutional revision and research, also serving on the United States National Committee of the International Electrotechnical Commission.

For the other offices of the Institute the following selections were made: For vice-presidents, Middle Eastern District—J. L. Beaver, associate professor of electrical engineering, Lehigh University, Bethlehem, Pa.; Southern District—C. O. Bickelhaupt, vice-president Southern Bell Telephone & Telegraph Co., Atlanta; North Central District—O. J. Ferguson, dean College of Engineering and professor of electrical engineering, University of Nebraska, Lincoln; Pacific District—E. R. Northmore, superintendent of electric distribution, Los Angeles Gas & Electric Corp., Los Angeles; Canada District—A. B. Cooper, general manager Ferranti Electric, Ltd., Toronto.

For managers: F. C. Hanker, manager central-station engineering, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; H. P. Liversidge, vice-president and general manager Philadelphia Electric Co., Philadelphia; E. B. Meyer, chief engineer, Public Service Production Co., Newark, N. J.

For treasurer: George A. Hamilton, electrical engineer (retired), Elizabeth, N. J.

These official candidates, together with any independent nominees that may be proposed later in the manner specified by the constitution and by-laws, will be voted upon by the membership at the spring election.

St. Louis Engineers Air Views at Dinner to Senators

A number of short talks on matters of public interest presented from the point of view of engineers, featured a dinner tendered Senators and Representatives from St. Louis, Mo., and St. Louis County by the Engineers of St. Louis under the auspices of the St. Louis Institute of Consulting Engineers, at the University Club, St. Louis, Dec. 14.

Obituary

George Simpson, formerly chief engineer of the Poole Engineering & Machine Co., of Baltimore, Md., died Dec. 18, aged 79 years. At an early age Mr. Simpson went to Baltimore to work for the late Robert Poole, founder of Poole & Hunt, now the Poole Engineering & Machine Co. He early became the chief engineer, which position he occupied until 1896, when he resigned to become supervising engineer for the Farrel Foundry & Machine Co., of Ansonia, Conn. After five years' service in this capacity, he resigned again to become associated with the Poole company as their consulting engineer. About two years ago it was necessary for him to retire from active duties.

Personal Mention

J. P. Greenwood, who has been connected with McClave-Brooks Co. for a little over a year, returned to Dallas, Texas, Jan. 1, to engage in engineering.

A. H. Schmidt, Jr., graduate of the Sibley School of Mechanical Engineer-

ing, Ithaca, N. Y., is working for the General Electric Co. in the research department.

J. R. Thompson, formerly acting works manager of the Trafford works of the Westinghouse Electric & Manufacturing Co., has been promoted to works manager of the same plant. The appointment is to take effect immediately.

Col. Hugh L. Cooper, accompanied by J. P. Ohsol, vice-president of the Amtorg Trading Corp., recently sailed for Moscow, Russia, to discuss with the Supreme Economic Council a contract for the construction of the proposed superpower project on the Dnieper River in Soviet Ukraine.

H. C. Mode has recently joined the Camden, N. J., plant staff of the American Brown Boveri Electric Corp. Mr. Mode is a graduate of Cornell University and has had about twenty years' experience with the Westinghouse Electric & Manufacturing Co., originally in Pittsburgh, Pa., and lately in Philadelphia.

Business Notes

Robert W. Adams, E. E., Providence, R. I., announces the publication of a third revised edition of the Adams Transmission Line Calculator.

The Sullivan Machinery Co.'s Butte, Mont., office, James G. Graham, manager, has been moved from 48 East Broadway to 54 East Broadway.

The Industrial Power Equipment Co. announces the removal of offices Jan. 1 to 421 West Camden St., Baltimore, Md., where offices and warerooms will be combined.

The Industrial Electric Motor & Tool Co., 1 Howard St., New York City, announces that Alvin S. Rich, formerly of Wagner Electric Corp., is now associated with the company at its New York branch.

The Burke Electric Co., Erie, Pa., manufacturer of motors, generators and welding equipments, announces the appointment of H. C. Lemire, 407 South Fourth St., Minneapolis, Minn., as district sales agent for Minnesota, the Dakotas and the northern portion of Wisconsin.

The Langman Electric & Engineering Co., Portland, Ore., has leased office space at Ninth and Davis Sts., and will engage in electric motor work, handling installations for mills and power plants throughout the Northwest. The company was incorporated recently, with J. D. Langman as president.

Cahill & Douglas, engineering firm, 217 West Water St., Milwaukee, Wis., has been dissolved. In the same quarters a general engineering business will be conducted by Chas. A. Cahill & Sons with an enlarged scope of services, the new firm being prepared to render service in the branches of civil, mechanical, electrical, architectural and industrial engineering. Members of the firm are Charles A. Cahill, Ralph H. Cahill, Charles A. Cahill, Jr., and B. C. Bugbee.

Auburn Stoker Corp., of Auburn, Ind., announces the appointment of F. A. Moreland as manager of sales.

Coming Conventions

American Engineering Council. Annual meeting at Washington, D. C., Jan. 13-15. L. W. Wallace, 24 Jackson Place, Washington, D. C.

American Institute of Electrical Engineers. Winter convention at New York City, Feb. 7-10; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at St. Louis, Mo., Jan. 25-28; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

Chicago Power Show, at Chicago, Feb. 15-19. G. E. Pfisterer, managing director, 53 West Jackson Blvd., Chicago.

Engineering Institute of Canada. Richard John Durley, secretary, 176 Mansfield St., Montreal, Que. The forty-first annual general and general professional meeting will be held at Montreal on Thursday, Jan. 27, and will be adjourned to reconvene at Quebec City at the Chateau Frontenac Hotel Feb. 15, continuing on the two succeeding days.

Midwest Power Conference, at Chicago, Feb. 15-18. Sessions will be held in the Coliseum concurrently with the Chicago Power Show; G. E. Pfisterer, secretary.

National Association of Stationary Engineers—Annual convention at Los Angeles, Aug. 22-27.

National Association of Stationary Engineers. New England States convention at Portland, Me., June 17-18. Thomas H. Clark, president, Worcester, Mass.; Robert Johnson, secretary, 65 Charlotte St., Worcester, Mass.

National Electric Light Association. A. Jackson Marshall, secretary, 29 West 39th St., New York City. Annual convention at Atlantic City, week beginning June 6.

National Marine Engineers' Beneficial Association. Fifty-second annual convention at the Hotel Franklin Square, Washington, D. C., Feb. 14. Albert L. Jones, secretary-treasurer.

The general sales office has been established in Chicago at 606 Hartford Bldg. Mr. Moreland, who has had long experience in the combustion field, will have under his direction the sales of a new and improved line of semi- and full-mechanical stokers for all types of boilers.

The Buffalo Forge Co. and the Buffalo Steam Pump Co. announce that, beginning Jan. 1, their Philadelphia office in the Land Title Building, will be in the charge of W. S. Koithan and R. W. Pryor, Jr., who have for many years been joint managers of the New York office. They will continue to manage the New York district and, with an enlarged engineering organization, will be of service to those interested in the application of equipment for heating, drying, mechanical draft, air conditioning and pumping.

Tentative Standards for steel and cast-iron flanges and flanged fittings and for cast-iron screwed fittings have been issued in proof form by a subcommittee of the Sectional Committee on the Standardization of Pipe Flanges and Fittings, under the procedure of the A.E.S.C. These proofs are being distributed by the A.S.M.E. for comment and criticism, and those having to do with these materials should apply to C. B. Le Page, assistant secretary of the society, for copies.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run except Pittsburgh gas slack:

Bituminous Net Tons	Market Quoting	Dec. 20 1926
Pool 1	New York	$3.50@$3.90
Smokeless	Boston	2.50
Clearfield	Boston	2.35@ 2.90
Somerset	Boston	2.50@ 3.00
Kanawha	Columbus	1.90@ 2.25
Hocking	Columbus	1.90@ 2.25
Pittsburgh	Pittsburgh	2.00@ 2.25
Pittsburgh gas slack	Pittsburgh	1.65@ 1.80
Franklin, Ill.	Chicago	2.50@ 2.75
Central, Ill.	Chicago	2.00@ 2.25
Ind. 4th Vein	Chicago	2.25@ 2.50
West Ky.	Louisville	1.25@ 1.75
S. E. Ky.	Louisville	1.75@ 2.25
Big Seam	Birmingham	1.75@ 2.00
Anthracite Gross Tons		
Buckwheat No. 1	New York	2.50@ 3.50
Buckwheat No. 1	Philadelphia	2.20@ 3.00
Birdseye	New York	1.25@ 2.00

FUEL OIL

New York—Dec. 29, light oil, tank-car lots; 28@34 deg. Baumé, 5¾c. per gal.; 36@40 deg., 6¼c. per gal. f.o.b. Bayonne, N. J.

St. Louis—Dec. 21, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.05 per bbl.; 26@28 deg., $2.10 per bbl.; 28@30 deg., $2.15 per bbl.; 30@32 deg., $2.20 per bbl.; 32@36 deg., gas oil, 6.3c. per gal.; 38@40 deg., 7.37½c. per gal.

Pittsburgh—Dec. 21, f.o.b. local refinery; 30@34 deg., fuel oil, 6½c. per gal.; 36@40 deg., fuel oil, 6¾c. per gal.

Philadelphia—Dec. 23, 27@30 deg., $2.52@$2.58 per bbl.; 13@19 deg., $1.725@$1.785 per bbl.

Cincinnati—Dec. 20, tank-car lots f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago— Dec. 27, tank-car lots f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.35 per bbl.; 26@30 deg., $1.45; 30@32 deg., $1.65.

Boston—Dec. 20, tank-car lots f.o.b. 12@14 deg. Baumé, 4.65c. per gal.; 28@32 deg., 5.9c. per gal.

Dallas—Dec. 11, f.o.b. local refinery, 26@30 deg., $1.75 per bbl.

Trade Catalogs

Unit Coal Pulverizers — The Aero Pulverizer Co., 111 Broadway, New York City, has issued bulletin 36 on aero unit coal pulverizers.

Fans and Blowers — The American Blower Co., Detroit, Mich., has devoted bulletin No. 8001 to "Sirocco" fans and blowers. This booklet is replete with illustrative figures and tables.

Strainers—The Morton Engineering Co., manufacturing engineers, 2050 N. Leithgon St., Philadelphia, Pa., discuss in bulletin No. 101 the "Meco" duplex or twin strainers of suction type.

Recording Instruments — The C. J. Tagliabue Manufacturing Co., 18-88 Thirty-third St., Brooklyn, N. Y., temperature engineers, has recently published the Tag recorder catalog No. 905C, covering Tag mercury, vapor tension and gas-filled recording thermometers, dial indicating thermometers, recording hygrometers and psychrometers, time operation recorders, vacuum and pressure recorders, Tag recording controllers, etc.

Automatic Mechanical Stokers—The Joseph Harrington Co., Harvey, Ill., describes in catalog No. 100 the "King Coal" automatic mechanical stoker designed and built by the company, which is a subsidiary of the Whiting Corp. This stoker is fashioned especially for small boilers rated from 40 to 250 hp. for either heating or power.

New Plant Construction

Arkansas—Dierks Lumber & Coal Co., 700 Gates Bldg., Kansas City, Mo., is having plans prepared for the construction of a lumber mill including power plant, etc. near Hot Springs. Estimated cost $1,000,000. Private plans.

Calif., Colusa—Union Ice Co., 354 Pine St., San Francisco, is having plans prepared for the construction of an ice plant here. Estimated cost $40,000. Private plans. Equipment will be required.

Calif., Los Angeles—W. Bruce, 621 Pacific National Bank Bldg., Archt., is preparing plans for the construction of an 8 story hotel and apartment building including steam heating system at Rodney Dr. and Los Feliz Blvd. Estimated cost $1,250,000. Owner's name withheld.

Calif., Los Angeles — H. J. Schmidt, Brooklyn, N. Y., is having plans prepared for the construction of a 12 story apartment including steam heating system, 4 elevators, etc. Magnolia St. and Washington Blvd., here. Estimated cost $800,000. H. D. Frankfurt Co. Inc., 1096 North Western Ave., Los Angeles, Calif., is architect.

Calif., Richmond—Ford Motor Car Co., Highland Park, Mich., is having plans prepared for the construction of an assembling building including power plant, etc., here. Estimated cost $1,000,000. Private plans.

Calif., San Francisco — U. S. Engineer Office, 85 Second St., cancelled bids which were to be opened Jan. 6 for a 20 in. booster pump. Will probably readvertise soon.

Calif., San Luis Obispo—San Luis Obispo Ice & Cold Storage Co., c/o Hamm, Grant & Bruner, Ferguson Bldg., Los Angeles, Engrs., is having plans prepared for the construction of a cold storage plant, here.

Fla., Tallahasse—B. H. Bridges, City Auditor and Clerk, will receive bids until Jan. 11 for a 1200 g.p.m. deep well pump, 3 ph., 60 cycle, 2300 v. against a total of 290 ft. head.

Ga., Macon—City will receive bids until Jan. 11 for the installation of a 10,000,000 gal. centrifugal pump in Riverside pumping station.

Ill., Chicago — Amalgamated Clothing Workers of America, 409 South Holsted St., is having plans prepared for the construction of a 5 story, labor temple at Ashland Ave., and Van Buren St. Estimated cost $1,000,000. W. W. Ahlschlager, 65 East Huron St., is architect.

Ill., Chicago—The Bemis Co., 332 South Michigan Ave., wants prices and catalogs for steam and hydro-electric power plant equipment, also transmission line equipment.

Ill., Chicago—P. Gerhadt, 64 West Randolph St., Archt., will receive bids until Jan. 5 for the construction of an 8 story hotel including vacuum heating system, two elevators, etc., at 4542 Malden St., for A. Blau, 2425 Lawrence St. Estimated cost $1,100,000.

Ill., Chicago — Arthur Kruggel & Co., 1865 Broadway, will soon receive bids for the construction of a 15 story apartment at Wellington Ave. and Sheridan Rd. Estimated cost $1,500,000. Roy F. France & Co., 105 North Clark St., are architects.

Ill., Chicago — Madison Clark Building Corp., c/o W. W. Ahlschlager, 65 East Huron St., Archt., is having plans prepared for the construction of a 23 story office and stores building at Clark and West Madison Sts. Estimated cost $2,700,000.

Ill., Chicago — Pancoe Bros., 123 West Madison St., is having plans prepared for the construction of a 35 story office and stores building at Monroe and Wells Sts. Estimated cost $3,500,000. Hall, Lawrence & Ratcliff, 123 West Madison St., are architects.

Ill., Chicago—O. Woll, 169 North Ada St., awarded contract for the construction of a boiler house at 1938 Carroll Ave. Estimated cost $4,800.

Ind., Indianapolis—Riley Memorial Hospital Assn., 528 Lockerbie St., is having preliminary plans prepared for the construction of a hospital and nurses' home. Estimated cost $500,000. R. F. Daggett, 922 Continental Bank Bldg., is architect.

Ia., Cedar Rapids—City, H. F. Blomquist, City Hall, Supt., plans an election in spring to vote $350,000 bonds for waterworks improvements including filter plant, four new wells, pumping equipment, tank on tower, etc.

Ia., Davenport—Clausen, Kruse & Klein, 910 Kahl Bldg., Archts., will receive bids about Jan. 10, for the construction of a 14 story bank and office building, including 3 elevators, etc. for American Commercial & Savings Bank. Estimated cost $1,250,000. Weary & Alford, 1923 Calumet Ave., Chicago, Ill., are associate architects.

Ia., Eagle Grove—City plans the construction of a light and power plant. H. L. Cory & Co., Aberdeen, S. D., are engineers.

Kan., Manhattan — State Agricultural College, plans the construction of a new power plant. Estimated cost $375,000.

La., Farmerville—J. W. Stancil Jr., Mayor and Bd. of Alderman, will receive bids until Jan. 11 for waterworks improvements including water well, pump house, two 500 g.p.m. motor driven, centrifugal or oil engine driven power pumps, 50,000 gal. tank on tower, etc. Swanson & McGraw Inc., 426 Batler Bldg., New Orleans, is engineer.

La., Winfield—City is having surveys made for waterworks improvements including pumping equipment, mains, etc. Estimated cost $50,000. C. D. Evans, 414 Levy Bldg., Shreveport, is engineer.

Me., West Enfield—Bangor Hydro Electric Co., E. M. Graham, 84 Harlow St., Bangor, is receiving bids for the construction of a hydro-electric development, here. Private plans.

Mass., Boston—Bureau of Supplies & Accounts, will receive bids until Jan. 5 for furnishing transformers, oil circuit breakers, etc. at Navy Yard.

Mich., Detroit—Bd. of Water Comrs., 176 East Jefferson Ave., plans the construction of a 6 story office building including steam heating equipment on Jefferson Ave. Estimated cost $800,000. Architect not selected.

Mo., Cape Girardeau — Syndicate, c/o E. E. Singleton, 626 Pine St., St. Louis, will soon receive bids for the construction of a 6 story hotel at Broadway and Fountain Sts. Estimated cost $500,000. Pleitsch & Price, Arcade Bldg., St. Louis, are architects.

Mo., Kansas City—A. H. Priestley, Chillicothe, Ill., plans the construction of a 6 story hotel and theatre building at 3517 Troost St. here. Estimated cost $500,000. Dodd & Finney, 800 Graphic Arts Bldg., Kansas City, Mo., are architects.

Mo., St. Louis—Fox-St. Louis Theatre, c/o C. H. Crane, 542 Griswold St., Detroit, Mich., Archts., will soon award contract for the construction of a 19 story theatre and office building including steam heating equipment, elevators, etc. here.

Neb., Ord—City will receive bids until Jan. 7 for one unaflow steam engine direct connected to a.c. generator and exciter.

N. J., Atlantic City—C. H. Roberts, 112 South 16th St., Philadelphia, Pa., Archt., awarded contract for the construction of a 10 story apartment at 117 South Illinois St. here, to J. N. Gill Construction Co., City Center Bldg., Philadelphia, Pa.

N. J., Newark—Hotel Pennsylvania, Broad & Emmet Realty Co., c/o N. Harris, 790 Broad St., Archt., is having plans prepared for the construction of a 12 story hotel including 8 elevators, etc. Estimated cost $2,500,000.

N. Y., Brooklyn—Penmar Realty Corp., c/o Shampan & Shampan, 188 Montague St., Archts., is having plans prepared for the construction of an apartment including steam heating system, 2 elevators, etc., at Penn St. and Marcy Ave. Estimated cost $500,000.

N. Y., Buffalo—R. G. Summers, 158 Swan St., wants prices and catalogs for Diesel engines.

N. Y., New York—Avlum Realty Corp., c/o G. & E. Blum, 415 Lexington Ave., Archts., is having plans prepared for the construction of a 17 story office building including steam heating system, 3 elevators, etc., at 545-551 8th Ave. Estimated cost $900,000.

N. Y., New York—Fifty One West Eighty Sixth St. Corp., c/o Sugarman & Berger, 345 Madison Ave., Archts., is having plans prepared for the construction of a 16 story apartment. Estimated cost $500,000.

N. Y., New York—Glick & Dumas, 400 East Fordham Rd., Archts., are preparing plans for the construction of a 9 story apartment on Gerard Ave. Estimated cost $2,500,000. Owner's name withheld.

N. Y., New York—V. Guinzburg, 485 5th Ave., awarded contract for the construction of a 9 story apartment at 230 East 48th St. to C. Herman Contracting Co., 155 East 42nd St. Estimated cost $550,000. Steam heating system, 2 elevators, etc., will be installed.

N. Y., New York—Seven Hundred Ten West End Ave. Corp., c/o G. F. Pelham, 570 7th Ave., Archt., is having plans prepared for the construction of a 15 story apartment including steam heating system. Estimated cost $600,000.

O., Cincinnati—American Druggists Fire Insurance Co., Mercantile Library Bldg., plans the construction of a 10 story office building on Central St. Estimated cost $600,000. J. G. Steinkamp, Mercantile Library Bldg., is architect.

O., Cincinnati — Eureka Fire Insurance Co., 22 West 8th St., awarded contract for the construction of a 25 story office building at 8th and Vine Sts. to Foreman & Putnam, Marietta. Estimated cost $2,000,000.

O., Cincinnati—Union Central Life Insurance Co., Fourth and Vine St., awarded contract for the construction of an 8 story office building at Third and Vine Sts. to Ferro Concrete Co., Third and Elm Sts. Estimated cost $2,250,000.

O., Cleveland—City will receive bids until Jan. 7 for furnishing a turbine cylinder for Allis-Chalmers turbine.

O., Cleveland—State Dept. of Welfare, J. E. Harper, Dir., Columbus, plans the construction of a group of buildings including power plant, cold storage plant and equipment, etc. for State Hospital here. Estimated cost $85,000 and $115,000 respectively. H. B. Briggs, Ohio-Hartman Bldg., Columbus, O., is architect.

Oklahoma—F. & D. Dierks, 700 Gates Bldg., Kansas City, Mo., had surveys made for the construction of a hydro electric plant on Mountain Fork River here. Estimated cost $700,000.

Okla., Tulsa—C. W. Day, 502 South Boulder St., will receive bids about Jan. 25 for the construction of a 10 story office building. Estimated cost $800,000. A. M. Atkinson, 218 Mid-Continent Bldg., is architect. Horner Wyatt & Roodes, 468 Bd. of Trade Bldg., Kansas City, Mo., are engineers.

Pa., Chester—Ell-Der Construction Co., c/o L. Davidson, Franklin Trust Bldg., Philadelphia, will build an 8 story hotel at 9th St. and Deshong Dr. here. Estimated cost $1,200,000. Private plans. Work will be done by separate contracts.

Pa., Erie—United Hotels Co. of America, 25 West 45th St., New York, N. Y., plans the construction of addition to hotel here. Estimated cost $1,000,000.

Pa., Philadelphia—N. W. Ayer & Son, 308 Chestnut St., plans the construction of an 8 or 9 story office building at 204 South 7th St. Estimated cost $1,000,000. R. B. Benckert, Bellevue Ct. Bldg., is architect.

Pa., Philadelphia—Simon & Simon, 249 South Juniper St., Archts., will receive bids until Jan. 10 for the construction of a 30 story bank and office building including boilers, 22 electric elevators, etc. at Broad, Walnut and Sansom Sts. for Fidelity Building Corp., c/o Fidelity-Philadelphia Trust Co., 325 Chestnut St. Estimated cost $10,000,000.

Pa., Pittsburgh—Montefiore Hospital Assn., 33 Center St., awarded contract for the construction of a 3 and 4 story hospital on 5th Ave. to H. Miller & Sons, 2565 5th Ave. Estimated cost $1,500,000.

Tex., Dalhart—Dalhart Ice & Electric Co., is having plans prepared for the construction of an electric light plant, 4 units doubling the present capacity; ice plant, 80 ton daily capacity also 1,000,000 gal. reservoir, large well, and 3 water pumps. Estimated total cost $250,000. Owner is in the market for machinery and equipment.

Tex., Galveston—Jean Lafitte Hotel Co., c/o Shearn Moody, American National Insurance Bldg., will soon award contract for the construction of a 10 story hotel. Estimated cost $500,000. A. Fraser, 824 American National Insurance Bldg., is architect.

Tex., Laredo—M. Little c/o Hamilton Hotel, plans the construction of a 10 story addition to hotel including heating plant, refrigeration and circulating ice water systems, elevators, etc. Estimated cost $400,000. L. Harrington & Co., Builders Exchange Bldg., San Antonio, are engineers.

Tex., Lewisville—City voted $62,000 bonds for waterworks improvements including pumping equipment, mains, etc.

Tex., McLean—Southwestern Public Service Co., Amarillo, has acquired the municipal electric and ice plants and is having surveys made for improvements to increase the capacity of electric plant and additional tonnage to ice plant.

Tex., San Antonio—G. A. Duerler Mfg. Co., 218 West Commerce St., awarded contract for the construction of a cold storage plant to E. Oeffinger, Builders Exchange Bldg. Estimated cost $18,490.

Tex., San Antonio—P. & S. Hospital, c/o J. H. Cunningham, is having plans prepared for the construction of a 5 story hospital including heating plant, refrigeration system, 5 elevators, etc. Estimated cost $1,000,000. Phelps & DeWees, Gunter Bldg., are architects.

Tex., San Antonio—San Antonio Public Service Co., E. H. Kifer, V. Pres. and Gen. Mgr., 201 North St. Marys Sts., plans to purchase electrical transformers. Estimated cost $50,000.

Tex., San Antonio—Woodlawn Terrace Hotel Co., c/o P. M. Chamberlain, Builders Exchange Bldg., awarded general contract for the construction of a 12 story hotel at Donaldson Ave. and Woodlawn Terrace. Estimated cost $750,000. G. Willis, Builders Exchange Bldg., is architect. Bids will be received about Jan. 15 for heating, refrigeration and circulating ice water systems, 5 elevators, etc.

Vt., Castleton—Town is having plans prepared for the construction of a waterworks system including pumping station, etc. Barker & Wheeler, 26 State St., Albany, N. Y., are engineers.

Vt., Manchester—Equinox House, plans the construction of a heating plant. Estimated cost $25,000. Engineer not selected.

Wash., Seattle—Devonshire Hotel Corp., c/o Stuart & Wheatley, Walker Bldg., Archts., will receive bids about Jan. 10 for the construction of a 15 story hotel at 6th and Union Sts. Estimated cost $500,000.

Wis., Menomonie—City is having plans prepared for the construction of a power plant. Estimated cost $40,000. Boilers, motors, fans, etc. will be required.

Wis., Milwaukee—House of Good Shepherd, 5010 North Ave., will soon receive bids for the construction of a group of buildings including power plant, etc. Estimated cost $350,000. Eschweiler & Eschweiler, 210 Mason St., are architects.

Wis., Milwaukee—Schroeder Hotel Co., 86 Michigan St., will soon award contract for the construction of a 23 story hotel on Grand Ave. Estimated cost $3,000,000 to $4,000,000. Holabird & Roche, 104 South Michigan Ave., Chicago, Ill., are architects.

Ont., Cochrane—Abitibi Power & Paper Co., Iroquois Falls, plans the construction of a newsprint mill, 200 ton capacity here. Estimated cost $750,000 to $1,000,000. All equipment will be electrically operated.

Ont., Toronto—Canadian Pacific Ry. Co., Montreal, Que., plans the construction of new coach yards including power house, engine house, etc. at John and Fleet Sts. Estimated cost $3,000,000. J. M. R. Fairbairn, is chief engineer.

Ont., Toronto—Ramsey Stewart & Co., Northern Ontario Bldg., is having plans prepared for the construction of a 10 story hotel including steam vacuum system, refrigeration equipment, electric elevators, etc. at Bloor St. and Avenue Rd. H. G. Holman, Northern Ontario Blvd., is architect.

Ont., Toronto—G. Wright, W. House and E. M. Carroll, Carlsrite Hotel, is having plans prepared for the construction of a 19 story hotel including steam heating system, electric elevators, etc. at King and York Sts. Estimated cost $5,000,000. Ross & MacDonald, 1 Belmont St., Montreal, Que., are architects. J. M. Lyle, 230 Bloor St. W., Toronto, Ont., is associate architect.

Mexico, Michoacan—Group of American and Canadian Capitalists, awarded contract for the construction of a dam on the Lerma River near here to Mexico Light & Power Co., Gante St., Mexico City. Estimated cost approximately $16,000,000. Upon completion of the dam a hydro-electric plant will be constructed. Owners will probably purchase machinery.

POWER

Equipment Information Bureau

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